VOLUME 36
NUMBER 9

SEPTEMBER, 1949

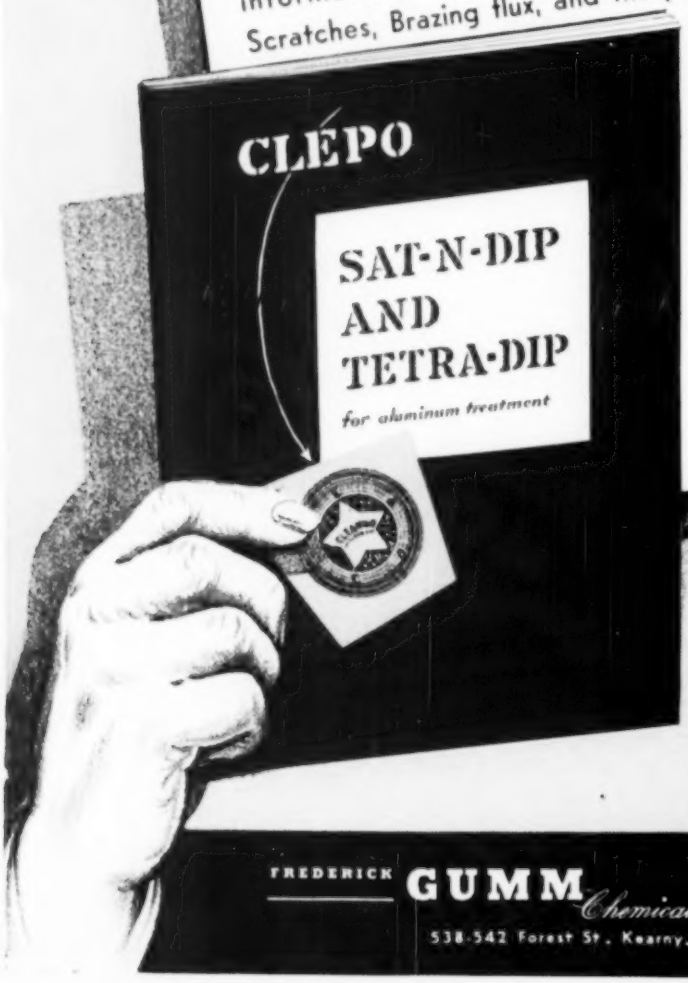
plating

CLOSING THE BOTTLE

See Contents Page 903

Are you Chemically Finishing ALUMINUM

If so, send for this Booklet which gives valuable information on Satin finishing, removal of Tool marks, Scratches, Brazing flux, and the preparation of Aluminum.



For Painting
Spot Welding
Heliarc Welding
Burnishing
Sat-N-Dizing
Anodizing

FREDERICK GUMM Chemical Company Inc.
538-542 Forest St., Kearny, N. J.

FOR FURTHER INFORMATION, USE READER SERVICE CARD: INDICATE A 680.

1 Better than Naphtha, kerosene or chlorinated solvents for plater's cleaning

2 No harsh action ... operator's ha... skin, no...

3 Leaves ... objectionable o...

4 ...Not contaminated by oil, grease or pigmented buffing compounds

5 Self dispersing and quick rinsing

6 Speeds ... cleaning cycle. Replaces ... for phospha... treatments

7 Safe for ALL metals, including aluminum, copper, brass, etc.

8 Does not contaminate alkali cleaners

9 No heat required. Operates at room temperature, 70-90 F

10 Insures brighter, smoother, less porous electrodeposits

works like magic

ENTHONE

Emulsion Cleaner 75

removes stubborn particles of solid grease and grime INSTANTLY

Emulsion Cleaner 75 is a new development in emulsifiable solvents with the penetrating powers of aliphatic hydrocarbons, yet, dispersing in water immediately.

As a pre-soak it reaches pocketed oil, grease and persistent dirt that defy alkali cleaners.

Write today for new bulletin

Enthone, Inc.

442 Elm St., New Haven 2, Conn.

Spraying's Better...

For Buffing and Polishing!

Because:

1. Optimum quantity of composition always maintained on the buff—desired amount of composition is present for each piece buffed and assures proper cutting and coloring.

2. Spraying eliminates unnecessary wear—deficiency of composition causes excessive cloth wear.

3. Spraying with properly formulated compositions greatly simplifies cleaning after buffing with the proper types of cleaners.

4. From 50% to 75% less spray composition is needed for the same work as bar composition.

5. Spraying eliminates fire hazard by keeping the buff properly coated at all t mes—it's safe!

The Famous Siefen System is a Better Spraying System BECAUSE:

The Siefen System is designed by the finest engineers in their field. It's designed for your particular work and backed by the finest Spray Compounds on the market. Our Service is at your service—to increase your profits!

THE Siefen System
SPRAY EQUIPMENT
SPRAY COMPOUNDS
SPRAY SERVICE

J. J. SIEFEN CO.

5641 Lauderdale
Detroit 9, Mich.

8/50 FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 682.

Industry News

The Electric Products Company of Cleveland, Ohio, has appointed **Harry J. Fisher Associates** as its representatives for most of the Ohio and the panhandle of West Virginia. Harry J. Fisher Associates have offices in Cleveland and Cuyahoga Falls. In addition to The Electric Products Company, they represent Pennsylvania Transformer Company, Lapp Insulator Company, Cornell-Dubilier Electric Corporation and The Euclid Electric and Manufacturing Company. They have four application engineers handling the products of all Companies represented.

The Electro-Chemical Supply and Engineering Company of Paoli, Pa., announces a complete reorganization. The new officers and key men aggregate approximately a century of experience in this highly technical and specialized work. In addition to existing facilities, a new plant with 16,000 square feet of floor space has been fully equipped at Emmaus (Allentown), Pa.

The officers of the company are: Dr. C. R. Payne, President; J. William Grant,

Payne

Vice-President and Sales Manager; William A. Sesber, Treasurer and Production Manager; Walter L. Sheppard, Jr., is Advertising Manager and Export Sales Manager.

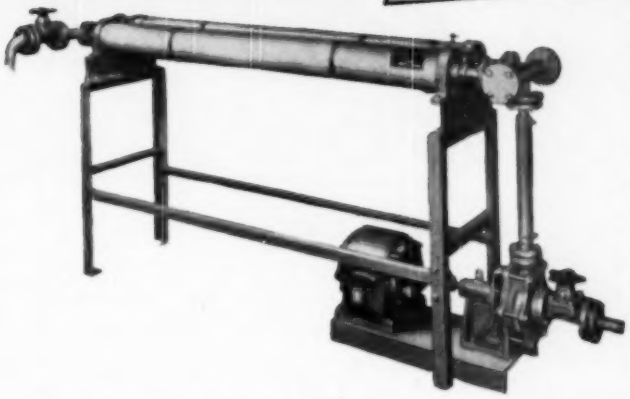
The company was founded in 1912, and was one of the first in the United States to manufacture acid-proof cements and to engineer acid-proof construction. It was the first company in the United States to manufacture a two-part fast-setting silicate cement (Duro), and was the first to manufacture and install Thiokol plasticized sulphur cement—then called Thiogrout, now known as Brimsto.

Binks Manufacturing Company Spray Equipment School. Educating foremen, supervisors, salesmen, jobbers, and business executives instead of the

Published monthly at 5800 N. Marvine St., Philadelphia 41, Pa. Entered as second class matter July 1, 1946, at the Post Office at Philadelphia, Pa., under Act of August 24, 1916. Copyright, 1949, by the American Electroplaters' Society, Inc. Subscriptions: Domestic and Canada, $4.00 per year, 50c per copy; Foreign, $6.00 per year, 75c per copy.

Industrial's HEAT EXCHANGERS

FOR PLATING SOLUTIONS



The Same Unit for Heating and Cooling

That's one big advantage of INDUSTRIAL'S Unit Heat Exchangers — you use the same unit for both heating and cooling. Maintaining the desired working temperature, by continued heating or cooling in the one unit, simplifies controls and operation. The units are adaptable to either manual or automatic control.

INDUSTRIAL'S Unit Heat Exchangers are available complete with pump and stand, or tubes alone can be had for wall or ceiling mounting. A wide choice of capacity, too, is possible by using from one to six tubes in a unit. Special units are readily engineered to meet unusual capacity or space requirements.

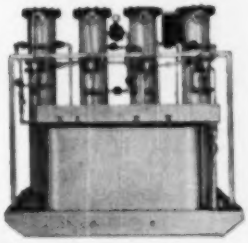
The design of the unit heat exchanger permits the use of pure nickel, copper, steel, or special alloy for the heat exchanger tubes, depending upon the plating solution. Rubber-lined headers and diaphragm valves are used when required. The pumping unit is of an alloy suitable to the solution involved. Ease of inspection and cleaning is assured by a simple header construction.

★ *Write for full information and recommendations*

INDUSTRIAL'S WATER DEMINERALIZERS and WATER SOFTENERS

for

Water that leaves no stains after hot rinse
Water that causes no unwanted precipitates in solutions

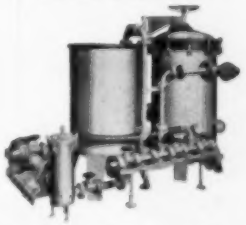


Model L-200 Four-Bed Industrial Water Demineralizer for a nominal flow rate of 200 gph. Other standard models available with capacities of 5 to 1000 gph. Special units of any capacity engineered to requirements.

INDUSTRIAL'S FILTERING SYSTEMS

for

Dependable Results in Solution Clarification



A typical Industrial Stationary Filter System. Standard models—portable and stationary types—are available in capacities of 100 to 15,000 gph. Special filters are engineered to meet unusual requirements.

INDUSTRIAL FILTER & PUMP MFG. CO.

1635 West Carroll Avenue • Chicago 12, Illinois

FILTERS — Pressure Type
PUMPS — Centrifugal
CORROSION TESTING APPARATUS — Salt Fog, Humidity
RUBBER DIVISION — Vulcanized Linings • Molded Products
WATER DEMINERALIZERS

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 683.

LOWER COSTS
Challenger Buffs
Take a good long look at an unbeatable team — the new Challenger Buff and Liquimatic, the modern liquid buffing compound made with Pure Seneca Tripoli. Same usual Miller premium quality, same careful workmanship, same skillful engineering and what a pair for whipping tough production problems.
The Challenger Buff, styled for longer life on tougher jobs, and Liquimatic, the buff saving, production boosting liquid compound offer your ideal answer to present day manufacturing conditions.
The Challenger-Liquimatic trend is growing daily as manufacturers see for themselves the numerous advantages and greater dollar value of this Miller team.
Investigate the Liquimatic-Challenger duo now — the team designed to help you hold the price line.
MILLER PRODUCTS
Liquimatic
LIQUID BUFFING COMPOUND
Portable demonstration and test equipment is available for tests at your plant. A request on your company letterhead will bring a Miller engineer to explain details and demonstrate to you what a saving this combination can effect in your production costs.
Liquimatic Contains only SENECA STANDARD TRIPOLI
J. C. MILLER COMPANY
GRAND RAPIDS, MICHIGAN

Industry News

workmen in spray painting methods and equipment is the unique feature of a school recently opened by the Binks Manufacturing Company. It is this group that must recommend and provide

the equipment, establish methods, and select the type of finish. Each class will be composed of men with allied interests.

The classes are held during the first full week of each month, except July and December, at the company's plant from 9 A. M. to 4 P. M., Monday through Friday. The classes are limited to twelve. William Beecham, a nationally known paint chemist and spray painting authority, is in charge.

The classes are conducted without charge to the individual, except for transportation and expenses while in Chicago. Application should be made two weeks or more in advance. Write to Mr. E. F. Watts, Binks Manufacturing Company, 3122 Carroll Avenue, Chicago 12, Ill.

Solvents Recovery Service, Inc., "We recover your solvents and thinners" formerly at 1019 Broad Street, Newark, N. J., has moved its main office to 101 Central Avenue, Westfield, N. J.

The Electrochemical Society will hold its Ninety-sixth Convention in the La Salle Hotel, Chicago, Ill., on October 12, 13, 14 and 15, 1949.

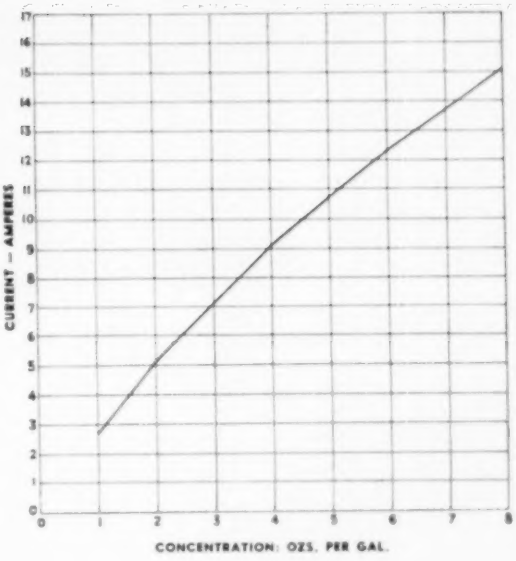
Symposia are being scheduled on Electrodeposition, Corrosion, and Organic Electrochemistry. Special round table sessions are being scheduled on batteries and organic electrochemistry.

Additional information may be obtained by writing to Dr. Henry B. Linford, Secretary of The Electrochemical Society, 235 West 102nd Street, New York 25, N. Y.

American Society for Testing Materials at its 52nd Annual Meeting announced the election of J. G. Morrow, Metallurgical Engineer of The Steel Company of Canada, Ltd., Hamilton, Ont., as president for the coming year. The first president from outside the United States, Mr. Morrow was born in Hamilton and attended the Collegiate Institute. He has been with his company since 1905. During World War II he

For faster cleaning of ferrous parts— WYANDOTTE F.S.

Current-conducting Characteristics of Wyandotte F.S.
(Steel Electrodes, 6 Volts, 180° F.)



Wyandotte F.S. is a heavy-duty reverse-current electrocleaner, especially designed to remove fabricating compounds and "smut" from ferrous parts prior to plating.

Because F.S. is a *balanced* formulation, it assures (1) high conductivity—see chart above, (2) fast and complete wetting and cleaning action, (3) controlled foaming and (4) long life in solution.

Your Wyandotte Representative will be glad to demonstrate the advantages of Wyandotte F.S. or any other Wyandotte Metal Cleaner at your convenience. He's always at your service.

Wyandotte
REG. U. S. PAT. OFF.

WYANDOTTE CHEMICALS CORPORATION
WYANDOTTE, MICHIGAN • SERVICE REPRESENTATIVES IN 88 CITIES

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 685.

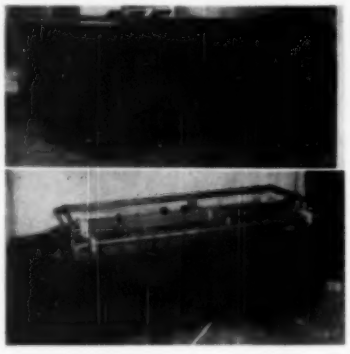
Good Casings Are

COST SAVERS

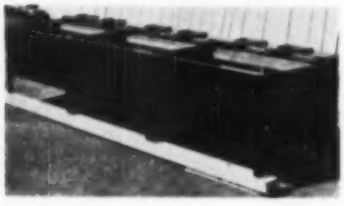
The first requisite of good exhaust casings is that they must have sufficient capacity. The second is that they should be designed to avoid early corrosion failure. We show here a few of the Storts fabricated casings that are saving money for satisfied customers.

These tanks have their own

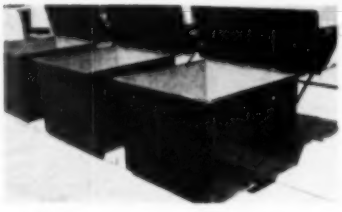
These casings illustrate the use of both end openings and top openings. The superior design and fabrication features are inside where they can't be seen. They involve good drainage, ease of cleaning and elimination of crevices where condensate and sludge might accumulate. The life of the tank shell and casing is not shortened by accelerated corrosion.



These have community casings



A single casing serves three medium tanks in this installation. Note two exhaust ports at top of casing for each tank.



Three tanks are served here by a single casing, having one large exhaust port at end of casing.

Storts engineering staff can help you to design your tanks and casings for maximum performance and long service life. Let us quote on your requirements—large or small.

STORTS WELDING COMPANY
INCORPORATED
42 Stone Street Meriden, Conn.

Manufacturers of Welded Fabrications to Specifications

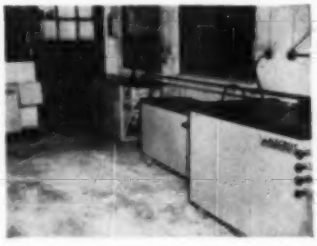
served the Canadian Government in a number of capacities, among them as its representative on the U. S. War Production Board. In A. S. T. M. he has been particularly concerned with the work of Committee A-1 on Steel.

Frank E. Richart, Research Professor of Engineering Materials, University of Illinois, Urbana, Ill., and an expert on concrete, has been elected Vice-President for a two-year term.

Members of the Board of Directors for the next three years are Robert D. Bonney, Assistant Manager of Manufacturing, Congoleum-Nayin, Inc., Kearny, N. J.; C. H. Fellows, Head of the Chemical Division, Research Department, The Detroit Edison Company, Detroit, Mich.; Harrison F. Gonnerman, Assistant to V. P. for Research and Development, Portland Cement Association, Chicago, Ill.; Norman L. Mochel, Manager of Metallurgical Engineering, Westinghouse Electric Corporation, Philadelphia, Pa.; and M. O. Withey, Dean of the College of Engineering, University of Wisconsin, Madison, Wis.

Cleaning Service. The Magnus Chemical Company, Inc., Garwood, N. J., manufacturers of cleaning chemicals and equipment, announces the inauguration of a free production-test cleaning service.

Companies wishing to test a new cleaning method or material can eliminate the

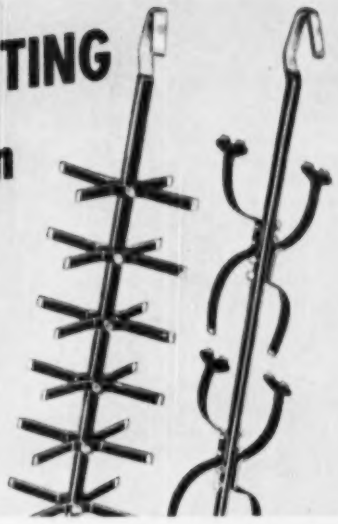


time, expense and bother of conducting cleaning tests on their own premises by taking advantage of this new service. The special building provided for the purpose is equipped with four mechanically agitated cleaning machines featuring three different types of agitation. These are in addition to a turntable-type spraying and rinsing machine. Two different types of cleaning tanks have also been installed, along with a drying oven, deburring and burnishing barrels, a steam gun and solvent-cleaner sprayer. Both heated and unheated machines and tanks are available.

With the above equipment it is now possible to determine not only the best chemicals, equipment and method for achieving a desired cleaning result, but actual cleaning times and costs can be accurately recorded as well.

BELKE UNIVERSAL PLASTIC COATING

For Lasting Rack Protection in All Plating Service



Belke-Developed Process hermetically seals Coating to Rack Metal

In plant after plant, BELKE Universal Plastic Coating has demonstrated resistance to plating acids and severe usage never before approached. Use on thousands of racks shows that it gives long service in all cleaning and plating solutions, including chrome and bright nickel.

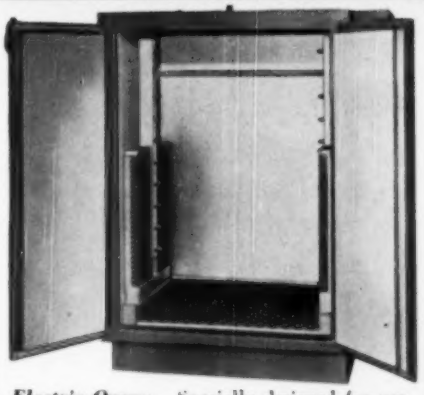
What is more, the BELKE-Developed Application Process bonds the coating to the rack metal with a hermetic seal that is stronger than the coating itself. Continuous temperature changes and flexing of tips do not weaken the bond. When ruptured by a severe blow or sharp point, solutions cannot penetrate between the coating and rack metal.

That's why BELKE Universal Plastic Coating, applied by the BELKE-Developed Process, gives rack protection never before equalled. Compare BELKE Universal Plastic with rack coatings you have tried. Just send a sample rack and let us coat it for you.

You can coat your own racks with BELKE Universal Plastic — or send them to BELKE. Write for particulars or consult your BELKE Service Engineer.

Belke MFG CO
947 N. Cicero Ave.
Chicago 51, Ill.
EVERYTHING FOR PLATING PLANTS

Equipment For Coating Racks With Belke Universal Plastic



Electric Ovens — Specially designed for pre-heating and curing racks coated with BELKE Universal Plastic. Automatically maintains any temperature between 300 and 450° F for which it is set. Insulation is 3" thick all around. Low current consumption. Nichrome V heating element is easily replaceable. Rack holding rod is easily adjusted to desired height.

Three Standard Sizes (Inside Dimensions)

	wide	high	deep
Model 1	24"	48"	24"
Model 2	36"	48"	24"
Model 3	48"	48"	24"

Other sizes made to specification.

Dipping Tanks — Deep, narrow steel tanks specially designed for efficiently coating racks with BELKE Universal Plastic.

Complete Rack Coating Installations — Planned for your requirements. Send details for recommendations or consult your BELKE Service Engineer.

Industry News

New Anode Package. The Harshaw Chemical Company, Cleveland 6, Ohio, now ships anodes in a cheap and simple palletizing arrangement which can be thrown away after use.

In making up the package the anodes are placed in a holding jig and corrugated board placed above, below and between the anodes. Steel straps are then threaded through two holes in each of two skids and up over the anodes. Drawing the strap tight brings the skid up to the anodes. The anode package, save for the skids, is then wrapped with burlap, sealed, labelled and is ready for shipment. This design gives all the advantages of a pallet shipment with none of the disadvantages. It is essentially a built-in pallet; easily handled with a fork-lift or hand truck due to the built-in skids, as shown in the figure.

The package stacks easily and quickly, and is readily opened. Since it is under tension, the one who cuts the strap should stand at the end and not the side of the package when it is opened.

The 52nd Annual Convention of the International Association of Electrotypers and Stereotypers will be held in Montreal, Canada, on September 19-20-21, 1949. A welcome party is planned for 7 P. M.

On Tuesday, September 20, after completion of Convention business, a cocktail party will be held, which will be followed by the main banquet with dancing and entertainment.

BUCKINGHAM PRODUCTS

TRIPOLI

Labor-Cost is High— Get an Extra "Helper" FREE!

THERE IS A "HELPER" IN EACH BAR OF TRIPOLI LISTED BELOW—A helper for cleaning operations, a big time and labor saver.

These new compounds contain solubilizing agents to insure easy removal in weak alkaline cleaning solutions . . . Especially adapted for use on die cast parts. All surface blemishes removed with minimum effort . . . a high luster easily obtained.

Write for Samples of these Die Cast Grades

T-401

T-605

T-607

REPRESENTATION FROM COAST TO COAST

The BUCKINGHAM PRODUCTS Co.

14100 FULLERTON AVE. • DETROIT 27, MICH.

SITUATIONS OPEN

TOP FLIGHT MANUFACTURING AGENTS AND JOBBERS

Wanted in certain territories to sell Schaffner's Buffing Compositions and Supplies. We specialize in White Finish, (Lime Composition), Grease Stick, Tripoli, Emery Cake, etc., in "Bar or Liquid Form". All up to 100 per cent saponifiable. These items can all be made to fit your particular customers' requirements. No account is too small or too large for our individual attention.

SCHAFFNER MANUFACTURING COMPANY

Schaffner Bldg.
Pittsburgh 2, Pa.

PLATING PARTNER WANTED
NO MONEY REQUIRED

Must be thoroughly experienced with anodizing, rustproofing, and particularly industrial hard chromium, with some knowledge of copper, silver and nickel.
Real opportunity for right man in central middle West. If sincere and ambitious, reply to:

P-9A, PLATING
P. O. Box 168, Jenkintown, Pa.

POSITION WANTED

Well known electroplater and chemist desires to make a new connection. Experienced in a large variety of finishing, such as automatic, still-tank and barrel plating of steel, brass and zinc, with common and precious metals, barrel finishing, electropolishing, etc. Good man with personnel.
Reply to:

P-9B, PLATING
P. O. Box 168, Jenkintown, Pa.

Longer Life - Greater Production

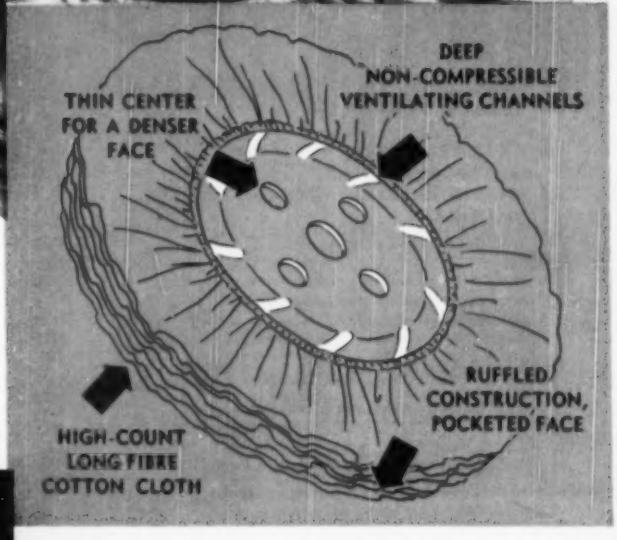
with CODMAN *BUFFS

*** CODMAN'S VENTILATED, NON-FRAY BUFF**

Is Made Under Patent Numbers
2,027,863; 2,094,650; 1,573,961.
Re. 19,894; 2,140,208.
Other Patents Pending.

THE MARK OF QUALITY

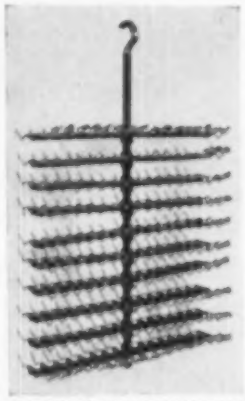
Write or Wire for Details


THIN CENTER FOR A DENSER FACE
DEEP NON-COMPRESSIBLE VENTILATING CHANNELS
HIGH-COUNT LONG FIBRE COTTON CLOTH
RUFFLED CONSTRUCTION, POCKETED FACE

F.L.&J.C.
CODMAN
COMPANY
ROCKLAND · MASSACHUSETTS

For Over 50 Years the Greatest Name in Buffs

BRANCH OFFICES
DETROIT • LOS ANGELES • GRAND RAPIDS • PHILADELPHIA



ONE RACK OR A THOUSAND

CALL HEADQUARTERS!

FOR

STANDARD RACKS and PARTS

WE WILL DESIGN RACKS FOR EVERY REQUIREMENT. LET US SOLVE YOUR PROBLEM AS WE HAVE FOR MANY LARGE AND SMALL MANUFACTURERS IN THE PLATING INDUSTRY.

A COMPLETE PLATING RACK SERVICE

A complete, engineered rack designed specifically for your work—or, the same standardized, interchangeable parts and materials, for those who build their own, are available at *Standard* in any quantity. When you buy *Standard* you buy *experience!* Couple this with our modern, fully-equipped plant, which is devoted exclusively to the manufacture of plating racks and parts, and you have the key to our recognized leadership in this field.

Excellent evidence of our leadership and aggressive research is our Stand-it-All Insulation. Flexible and tough! When bonded to the rack, it prevents plating up of the rack, saves current, plating material—*and the rack.*

COPPER AND WIRE AT TODAY'S WAREHOUSE PRICES

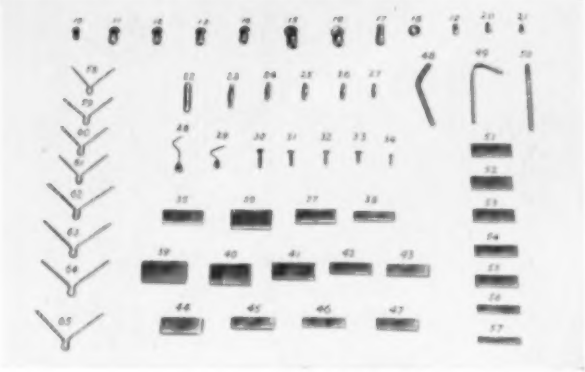
RACK INSULATION:
Quality and Service

INSULATING MATERIALS:
Stand-it-all Plastisol
Stand-it-all Neoprene
Stand-it-all XXX

PARTS:
Studs, brackets, bending jigs, tips, round edge copper, phosphor bronze wire, and aluminum.

RACK REPAIR KITS:

Write for Parts Catalog and Prices.



ONE PART OR A CARLOAD

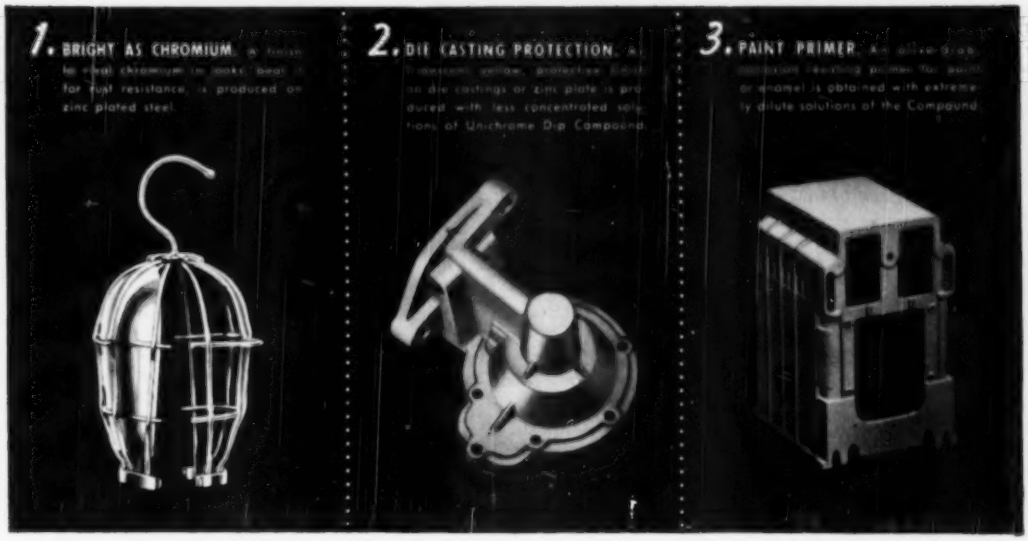
"RACKS IS OUR BUSINESS"

STANDARD PLATING RACK COMPANY

1913-25 N. PAULINA STREET CHICAGO 22, ILL.

FINISH FOR LESS
with the 3 zinc finishes

produced by UNICHROME DIP COMPOUNDS



Any one of these three finishes, chemically produced on zinc, can help you do an outstanding finishing job. They dress up a product—give it corrosion protection. And for less than you think. For the Unichrome Dip solution permits you to finish an average zinc surface for only a fraction of a cent per square foot!

Along with that saving also go the economies of long solution life and low operating expense. No time-eating polishing. Just a simple dipping cycle and there's your quality finish—one that's far better than cadmium alone, or better than nickel and chromium plate applied sparingly.

If you're plagued by high costs in finishing low-cost products, you ought to try Unichrome Dip Compound. Write for details.

HERE'S WHAT YOU CAN DO WITH UNICHROME DIP COMPOUNDS

- Produce on zinc plate a chromium-bright finish that stays bright. Can be soldered.
- Put an *iridescent* yellow or olive-drab finish directly on zinc base die castings which will bar "white" corrosion.
- Increase the corrosion-resistance of galvanizing with a brightly spangled finish or an olive-drab one.
- Prime *all* zinc surfaces for paint, enamel, or lacquers.

UNICHROME

PROCESSES AND MATERIALS

FOR SURFACES THAT SURVIVE

Chromium Plating • Porous Chromium • Unichrome* Copper
Unichrome Lacquers • Ucilon* Protective Coatings
Unichrome Stop-Off Lacquers and Compounds • Unichrome Dips
Unichrome Rack Coatings • Anozinc* Compounds • Unichrome Strip
*Trade Mark Reg. U. S. Pat. Off.

UNITED CHROMIUM, INCORPORATED

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FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 691.

THERE'S no need for paying the cost of excessive rejects when the trouble lies in poor cleaning of the steel surface before you begin your plating operation.

DOUBLE ELECTROCLEANING WITH MAGNUS CLEANERS IS THE ANSWER

First, you clean cathodically for 1 to 2 minutes in Magnus 94XX solution. This special alkaline cleaner for steel (and brass or copper) parts is provided with greatly improved wetting action by the use of a synthetic surface-active ingredient of Magnus' own manufacture. 94XX has the added advantage of giving ample current carrying capacity to provide the densities you want for effective cathodic cleaning. (If you want longer lasting solutions, preclean the parts before electrocleaning in Magnusol.)

Next, clean the work anodically for 1 to 3 minutes in Magnus 61XX. This strongly alkaline cleaner is also provided with the same superior wetting action as 94XX.

When the work is rinsed after anodic cleaning, the usual dilute acid dip is used, the work is again rinsed and is then ready to be plated. It is clean—chemically clean—and should go through any plating operation, automatic or manual, with complete elimination of any rejects caused by ineffective cleaning.

There are special Magnus materials for electrocleaning of die castings and other soft metals, as well as combinations of steel and soft metals. Let us know what you plate and we'll recommend a dependable procedure.

MAGNUS CHEMICAL COMPANY • 41 South Ave., Garwood, N. J.

In Canada—Magnus Chemicals, Ltd., 4040 Rue Masson, Montreal 36, Que.

Service representatives in principal cities

Personals

William J. Harshaw, President of The Harshaw Chemical Company, Cleveland, Ohio, on June 15 last was awarded the honorary degree of Doctor of Science by Western Reserve University in recognition of his scientific discoveries in the fields of ceramics and electroplating.

Carter

John A. Carter has been elected President of Oakite Products, Inc. The new chief executive has been associated with the Oakite organization for thirty-four years, serving in recent years as Assistant to the President and, since December, 1947, as General Manager. **D. C. Ball,** founder and President of Oakite, and long a pioneer in the development of specialized cleaning materials for industry, has been elected to the office of Chairman of the Board. Also announced is the election of **David S. Ball,** former Vice-President, to the newly created office of First Vice-President.

Arthur F. Wirtz, Jr., and **George L. Wirtz, Jr.,** grandsons of the late M. F. Wirtz, founder of the firm, have joined The Atlas Mineral Products Company and have been assigned to supervision and sales departments respectively at Mertztown, Pa.

Henn

Spencer L. Henn has joined the staff of United Chromium, Incorporated, as Field Sales and Service Engineer for the New England area. He will provide technical service to chromium plating clients of United Chromium and will also sell and service the complete line of Unichrome products and processes.

Mr. Henn is a graduate of Yale Uni-

The new way to polish contours - *with* Behr-Manning belts

Here's a way to really slash polishing costs and obtain better finishes too. The Behr-Manning engineered belt method produces quick finishes without wheel marks, eliminates operations, and reduces operator fatigue. And buffing is faster, too, on a Behr-Manning belt-polished job. No wild grain marks, and a smoother finish that buffs out easier. This new way of contour polishing gives your shop an immediate production advantage. Find out about it now.

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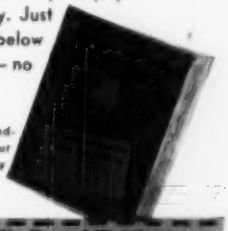
A Behr-Manning Field Engineer will be glad to show you how to set up this new method in your own plant. Equipment and installation are simple —with the "know-how" they will pay for themselves quickly. Just fill out the coupon below for a demonstration — no obligation.



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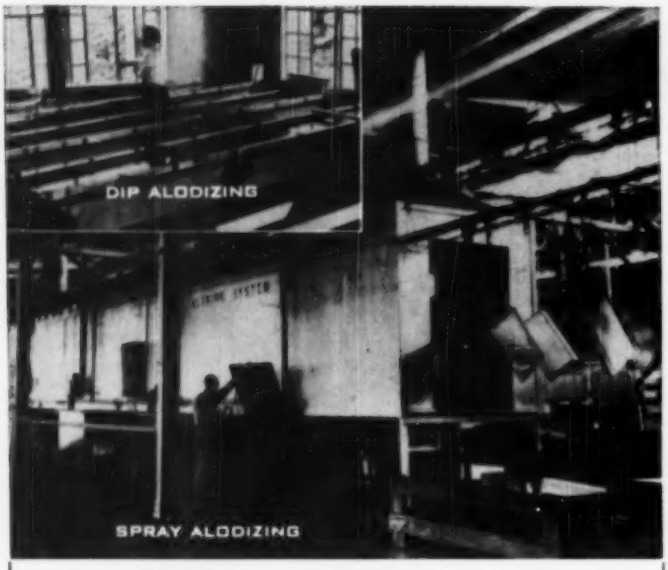

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"ALODINE" forms a skin-like coating firmly embedded in the aluminum. This protective skin is thin, tough and tight. It is extremely resistant to corrosion. It bonds paint firmly to the metal for the life of the finish.

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ALODIZING* is simple, quick, economical, easy to use, and effective. "ALODINE" can be applied by dipping, spraying, or brushing the work. It can be used to advantage in your own production. For details, write—or call Ambler 0486—for a descriptive folder on "ALODINE".

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Manufacturers of Metallurgical, Agricultural and Pharmaceutical Chemicals

Personals

versity with a Ph.B. in chemistry. Since his graduation he has served the metal finishing industries of Connecticut and Massachusetts as a representative of Apothecaries Hall Company.

Dr. Carl A. Zapffe and **Miss M. E. Haslem** have been notified by the Board of Directors of the Wire Association that they have been awarded a Certificate of Honorable Mention for presenting the outstanding paper to the Ferrous Division of

Dr. Zapffe

Miss Haslem

that industry in 1948. The paper, presented to the Annual Meeting in Pittsburgh on October 19, 1948, described the discovery that hydrogen gas is absorbed by certain steels from inhibited pickling solutions in quantities as great as from uninhibited acids, causing important damage which has previously been blamed on other factors. The research, conducted in conjunction with an Office of Naval Research contract for the past several years, went on to describe a corrective inhibitor of undisclosed composition.

The award will be presented at the Annual Banquet of the Wire Association in Chicago on October 19, 1949.

Harold E. Strang, of Schenectady, Engineering Manager of the Affiliated Manufacturing Companies Department of the General Electric Company, has been appointed Manager of the G-E Apparatus Department's Meter and Instrument Divisions at Lynn, Mass. He succeeded **Nicholas M. Du Chemin,** who recently was named an Assistant General Manager of the Department.

A native of Mechanicville, N. Y., Mr. Strang was graduated in 1922 from Rensselaer Polytechnic Institute with a B.S. degree in electrical engineering. He began his career with General Electric the same year.

Carl Bauer has been appointed Manager of Industrial Sales, and **W. E. Santoro,** Director of Laboratories of Standard Varnish Works of New York.

Mr. Bauer, a graduate Chemical Engineer, started with the Company as a chemist, later becoming Director of Research and then Director of Laboratories. He has lately been increasingly active in

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CONTROL YOUR BATHS, YOURSELF, AND LEARN THEIR OPERATION . SAVES DELAYS IN OUTSIDE TESTS . SAVES NON-PRODUCTIVE BATH TIME . REDUCES REJECTS . IMPROVES QUALITY . KEEPS YOUR BATHS AT BEST OPERATING EFFICIENCY AT ALL TIMES

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Backed by the Resources of

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(Long established supplier to American railroads)

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for the purpose of
Development, Manufacture and Sale
of Products and Processes
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the Application and Secondary Treatment
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This organization is engaged in the largest and most comprehensive research program ever carried out in the zinc field. After six years of development and field testing it now brings zinc electroplaters, hot dip galvanizers and zinc base die cast manufacturers and finishers many new processes and products which offer new levels of performance and economy, both for the finisher and the user. As the program moves forward many new developments will be released.

Watch for Further Announcements

A-ZED *inc.* 80 East Jackson Blvd., Chicago, Ill.

Laboratories at Waukegan and Riverdale, Ill. Factory at Waukegan.

Personals

sales and sales development. In January, of this year he was made a Director.

Mr. Santoro came with Standard Varnish Works in 1939, to take charge of the Company's Metal Decorating Division. He has had many years of experience in the paint and varnish industry and has made numerous contributions to the technological advancement of the industry.

J. M. O'Brien has been appointed Assistant Sales Manager of Kleen Chemicals, Inc., Dearborn, Mich. Formerly Southwestern Manager for another concern, he has more than 11 years of experience in the chemical cleaning fields. He will assist Mr. A. J. Pettit, General Sales Manager, in the company's plans for further expansion in industrial metal cleaning, as well as in other industries not previously covered.

Rylander

Allan A. Rylander has been elected President of Canadian Permag Products, Ltd., manufacturer of industrial cleaning compounds.

After five years with a private bank in Wall Street, Mr. Rylander joined Magnuson Products Corporation in Brooklyn in 1929. He went to Montreal in 1933 as Assistant Manager of Canadian Permag. In 1937, he became Assistant Treasurer and Manager, and in 1943 Treasurer. He was elected Director in 1944 and made General Manager in 1946. Mr. Rylander is also a Director of Magnuson Products Corporation in Brooklyn.

Morgan Jones is now Superintendent of the Wheatland, Pa., plant of the Maneely Chemical Company, Philadelphia, Pa.

Graduated as a Chemical Engineer from the Ohio State University where he was a member of Phi Delta Theta, Tau Beta Pi, and editor of "Ohio State Engineer", he became Production Supervisor for the Monsanto Chemical Company at Nitro, W. Va., did research in chromic oxide and iron oxide pigments for C. K. Williams & Company at Easton, Pa., and was Engineer and Chemical Plant Superintendent in the manufacture of phosphorus, phosphoric acid, sulfuric acid and superphosphate for the Phosphate Mining Company at Nichols, Fla. Mr. Jones comes to Maneely from the Calco

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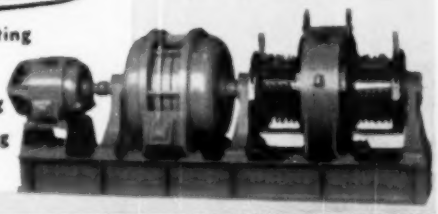

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Blakeslee, pioneer in mass production cleaning methods, is the logical source to answer your cleaning problems.

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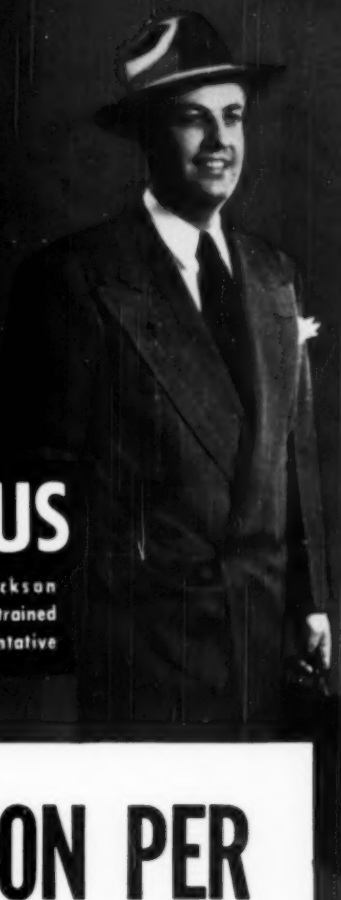

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BUY A QUALITY PRODUCT for greatest satisfaction and economy. Don't waste time and money experimenting with **"just as good"** or substitutes for **JACKSON AIRWAY** ***Ventilated*** **BUFFS.** These buffs are leading the field for maximum polishing and buffing efficiency.

Don't try to cut costs by buying cheaper buffs. **JACKSON AIRWAY** ***Ventilated*** **BUFFS** can make greater savings for you by increasing wheel-life and production . . . by producing better finishes to meet every requirement on all types of equipment.

The **JACKSON BUFF CORPORATION** has pioneered and developed the most outstanding and efficient bias type ventilated buff in the field to date.

We offer a wide range of types of buffs — and an equally wide range of prices.

Don't take quality for granted — try the **JACKSON AIRWAY** ***Ventilated*** **BUFFS** today!

JACKSON BUFF

Personals

Chemical Division of American Cyanamid Company at Marietta, Ohio, where he has been Production Superintendent since 1945.

George P. Gabriel, who recently received a degree in Chemical Engineering at Pennsylvania State College, has accepted a position as engineer with The Atlas Mineral Products Company at Mertztown, Pa.

H. D. McKinley has been appointed Works Manager of the new degreasing-solvent manufacturing plant being erected by Hooker-Detrex, Inc., at Ashtabula, Ohio. Mr. McKinley, who collaborated in the design, erection and initial operation of the Tacoma, Wash., plant of the Company, is transferring from his position as Manager of the solvents division of Detrex Corporation.

Molis

J. P. Molis, formerly District Manager of the Industrial Maintenance Department of the Diversey Corporation, has been named Promotional Manager of the newly formed Maintenance Department. This department replaces two former sales departments of Diversey—Industrial Maintenance and Institutional.

Mr. Molis joined Diversey 3½ years ago as a field service representative in the Industrial Maintenance Department.

Henry C. Speel, for over a year a Development Engineer with the Central Sales Department, General Aniline & Film Corporation, has been transferred to Antara Products where he will be engaged in sales engineering work. Mr. Speel has been in market development for the chemical industry for the past 20 years, the last 15 of which have been devoted to surface active agents.

TOUGHEST UNICHROME COATING YET!

Now, with COATING 218X, you'll spend even less to maintain racks

Compare this plastisol Unichrome coating for resistance to vapor degreaser, hot caustic and chromic acid solutions. You'll see why Coating 218X stands up longer, saves you money in *any* plating cycle. For among the chemicals used in plating cycles, those three are most destructive to rack coatings. Yet, results in our own laboratory, confirmed in that of a large automotive producer, prove they have *negligible effect* on Coating 218X!

Along with this remarkable chemical resistance goes extra *physical* toughness. Coating 218X has flexibility that absorbs hard knocks without chipping. Surface hardness resists accidental cutting and rough handling. Because it is free-rinsing, it permits continuous cycle operation with minimum dragout.

Write for new prices and data. Remember, if you have no baking facilities, you can still profit from the cost-cutting advantages of Coating 218X. Nearby applicators can serve you. We'll send you names.

UNICHROME

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RACK COATINGS—Products of

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OBITUARIES

Samuel Alsop, Sr., President of the Alsop Engineering Corporation since its inception thirty years ago and holder of numerous patents, died on July 7 of a heart attack at his summer home at Madison, Conn.

Born at Delaware Water Gap, Pa., Mr. Alsop was a New York Electrical School graduate. He showed inventive talents at an early age, and at 24 had patented his first filter and organized the Alsop Engineering Company in New York City. The concern moved to Milldale, Conn., in 1930. Mr. Alsop built the firm from a one-man shop into an enterprise that employs 130 people and maintains offices or representatives in every major city in the United States and in South America and Europe.

He leaves three sons, Samuel Alsop, Jr., Edmund Bell Alsop, and Carter Griscom Alsop of Meriden, Conn., and one sister, Miss Beatrice Alsop of New York City.

Charles O. Hardy, Foreman of Finishing for United-Carr Fastener Corporation, Cambridge, Mass., died suddenly on Thursday, July 14.

He was 56 years old and had been a member of Boston Branch of the American Electroplaters' Society since January, 1929, always taking an active part in Branch affairs as an officer as well as an ordinary member.

He attended the Society's Convention in Milwaukee with Mrs. Hardy, had a wonderful time at both the sessions and other affairs, and thought it one of the best conventions to date. He had been at work steadily since his return from Milwaukee, including the day before his death.

He will be sorely missed by his many friends.

for Better Plating Results

Change to **N-R**

SEYMOUR'S

Cold Solution Type

BARREL NICKEL BRIGHTENER

SEYMOUR'S N-R Bright Nickel for cold bath solutions saves you money and gives more uniform deposits in barrel plating of small articles. With an original addition of only 3 to 5 fluid ounces of N-R per 100 gallons of solution, a clean, even, decorative deposit of bright nickel up to .0001" can be obtained. Only 1 to 2 fluid ounces of N-R are needed per 100 gallons per load of work thereafter.

Seymour N-R cold type Brightener is simple to maintain and easy to control. Deposits are adherent to properly cleaned base metals, except zinc base direct, and may be chromium plated without prior buffing or wiping. Write for Bulletin No. 8 containing complete details.

Other Seymour Bright Nickel Processes are available for specific plating needs. Tell us your requirements.

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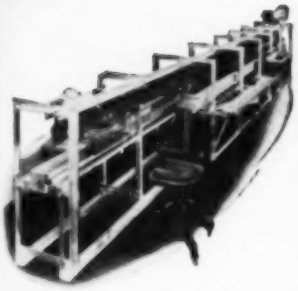
THE SEYMOUR MANUFACTURING COMPANY, SEYMOUR, CONNECTICUT

SEYMOUR

MEAKER Electroplating Machines

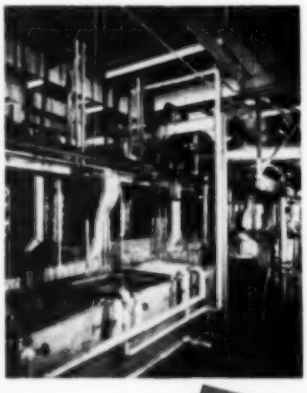
Tailored to Fit

Typical Meaker Straight-A-Way Automatic Machine. This machine was built for copperplating three rows of work simultaneously. It handles 125 racks per hour that are 16 inches wide, 14 inches thick, and 70 inches long.

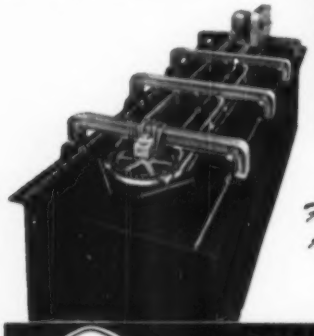


Meaker Special Machine designed for cleaning and silver plating small, brass contact clips. The unit is loaded at one point and the parts are carried through the operating sequence and automatically discharged into a container when completed.

Meaker Return-Type Automatic Machine for chromium plating the large variety of parts in a high-quality line of plumbing hardware.



A Meaker Semi-Automatic Machine for use in medium-output plating departments. This type equipment is used in large, job plating plants to supplement the capacity of automatic machines.



Equipment tailored to fit your requirements, making every operation in the plating sequence automatic, or as mechanized as possible, is the profitable way to handle electroplating on a production basis. This Meaker method applies equally well to departments with only moderate daily output and to the largest and heaviest automatic plating needs of the mass production plants. It offers not only a lower unit cost, but the production is increased, and a better and more uniform quality of product is assured.

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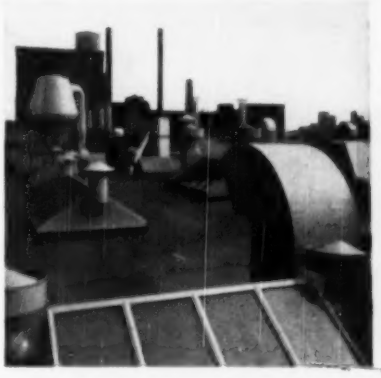
MICCROLOID is a tough, resilient, firmly adhering coating that stops corrosion in its tracks. Wherever corrosive conditions are severest – where ordinary coatings have failed – MICCROLOID will prove its worth. That's why it enjoys such wide application in varying industries – on plating equipment, acid and alkali rinse tanks, structural steel, factory walls and floors, pipe lines, air ducts, ventilating systems, process piping and tubing, water storage, water softening and refrigerating equipment, etc. A trial quantity of MICCROLOID is yours without cost or obligation. Merely write our office or your favorite distributor and specify your particular problem.

Improved MICCROLOID is available in aluminum, white, black, gray, blue, and clear.



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A New Prime Coat for MICCROLOID

A specially formulated primer . . . quick drying and flexible . . . which provides maximum adhesion on hard-to-stick-to metals such as brass, tin, lead, galvanized metal, zinc, steel, cadmium, magnesium, aluminum, or bronze. MICCROLOID Primer acts as a rust inhibitor . . . protects metal before painting . . . forms insoluble phosphates at the metal surface . . . prevents corrosion from creeping beneath the paint film . . . and provides a corrosion-resistant anchor coat.

Write for detailed bulletin.

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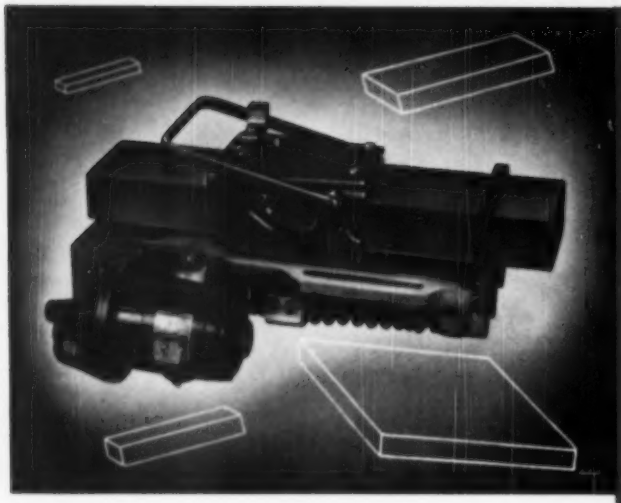
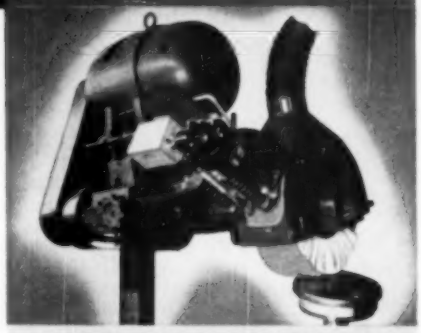


Stevens Precision-Molded Compounds are "Right" for the Job

Pay Off in Better, Faster, Lower Cost Automatic Buffing



HIGH operating speeds and pressures involved in automatic buffing require that the uniform density, quality and melting point of a composition be just "right", if buff wear is to be kept at a minimum while producing a high, uniform quality finish.

For years, Stevens has made a specialty of producing compositions which are exactly "right" for automatic buffing. This is done by an exclusive precision molding process which turns out cakes of composition of uniform size with straight edges and perfectly flat, parallel faces.

The uniform density, toughness and strength necessary to withstand the most severe usage, is the direct result of diligent quality-control used in every phase of manufacture. It begins with the "right" formula, mixed, melted and poured at the "right" temperature, into gravity molds with controlled cooling to produce a composition that is "right" for each specific application.

Stevens precision-molded compositions invariably deliver *a value far beyond purchase price* that pays off in extra performance on the job. You're entitled to that value. Get it in a Stevens precision-molded composition that is exactly "right" for *your* automatic buffing work.

Stevens has perfected a Liquid Tripoli Compound, which warrants your serious consideration. If interested, let us tell you more about it.

Stevens Precision-Molded Composition Offers These Advantages:

- **MORE ECONOMY IN USE** due to high melting point and tough texture. Cakes last longer, do not melt away or chip off.
- **LESS WASTE** because longer cakes reduce percentage of nubbins.
- **PERMITS LOWER INVENTORY** and more flexibility in composition use because strict adherence to exact dimensions allow two or more cakes to be clamped side by side and firmly held in applicator.
- **TROUBLE-FREE APPLICATION** is assured when automatic compound feeder handles perfect cakes.

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METAL FINISHING EQUIPMENT AND SUPPLIES DIVISION

The cover picture of a closed beverage bottle is part of a story on page 922 about the manufacture of crown corks.

PLATING is abstracted regularly in Chemical Abstracts, Engineering Index, Technical Data Digest and Bulletin Analytique.

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plating

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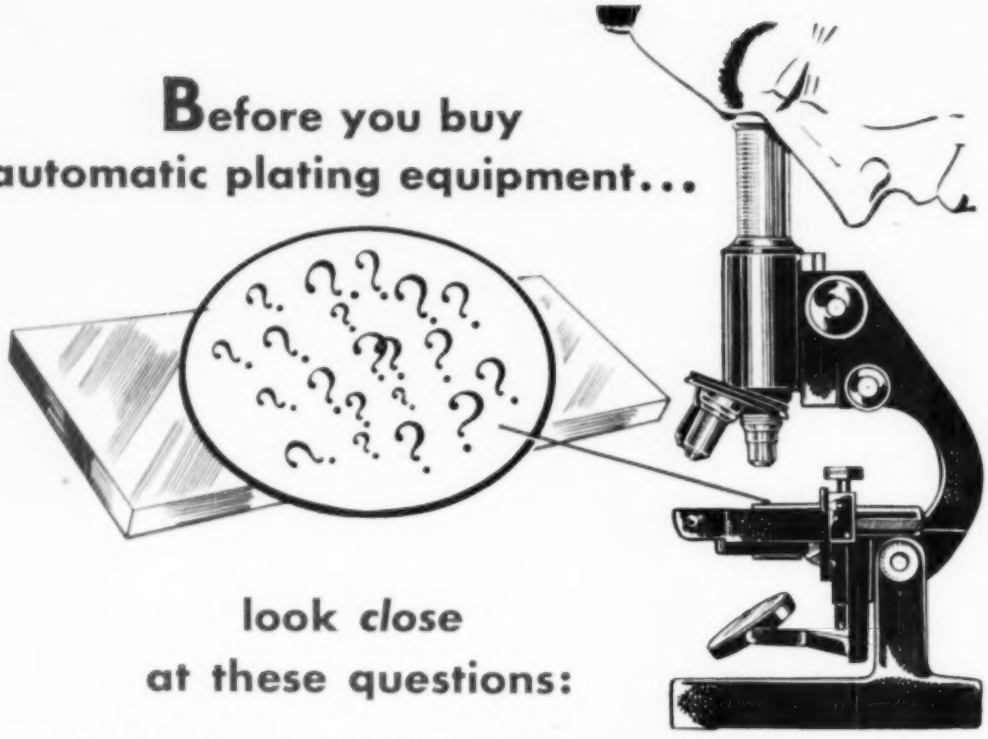

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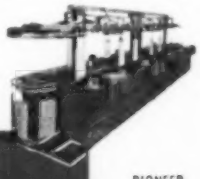

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DETROIT 11, MICHIGAN

Editorial

Plating and atomic energy

IN THESE DAYS of near-hysteria in Washington about the safety of our atom-bomb developments, it is well to recall that much progress is being made in the peacetime uses of atomic energy. Not only does the atomic bomb program necessitate much fundamental work on ordinary materials and development of new instruments of general usefulness, but it has opened up hitherto unheard-of possibilities of power production and high-temperature reactions, and has made possible manufacture of isotopes of many elements in substantial quantities. The radioactive isotopes have found many uses in medicine, but their widest application, and that of the stable isotopes, is likely to be in the industrial and the basic-science fields.

The radioactive isotopes are of particular interest because they can be used with particular facility as so-called tracers. It will be recalled that an isotope has all the properties of the ordinary element except for a different atomic weight and, in some cases, the ability to send out radiations of different kinds. Hence it can be incorporated in any chemical, and where there are more than one atom of a kind in a compound, one of them may be replaced wholly or in part by a radioactive isotope. By measurement of the radiation, the "tagged" atom can be followed through very complicated processes. In some instances this technique is used simply as a tool to detect and measure the concentration of a substance present in very small quantities; in others it is used to determine what portion of a molecule takes part in a particular process.

This technique has already been used in fields allied to plating. Among applications have been determination of the point of exhaustion of ion-exchange material for recovery of such substances as chromic acid, studies of the mechanism of tarnishing of silver plate, investigation of reactions between alkaline cleaning solutions and surfaces of steel, zinc, aluminum and silver, and detection of traces of soil left on cleaned surfaces.

We are certain that these are only the faint beginnings of the application of a very powerful tool. We can look forward to its use in finding the sources of outside contaminants of plating solutions, and in helping to determine the mechanism of bright plating, for example by finding out of what parts of the brightener molecules furnish the carbon found in certain bright nickels, to mention only two problems of interest to the plating technologist and researcher.

The Atomic Energy Commission now conducts schools to teach competent scientists and engineers the fundamentals of tracer research and the precautions required to protect workers from dangerous radiations. It also furnishes a wide variety of isotopes suitable for tracer studies.

As far as one can judge from the testimony of scientists, the present uproar has nothing to do with the efficiency of the Commission in its direction of military and civilian activities in this new field. Instead its difficulties seem to be largely of a political nature. It is hoped that its present very fruitful policies will be allowed to continue, and that an increasingly larger number of companies and individuals will make use of what is available.

Gustaf Soderberg

SUMMARY:

A special bend test for studying hydrogen embrittlement of steels exposed to hydrogenizing conditions is applied to various copper electroplating processes.

Both mild steel, SAE 1020, and stainless steel, AISI 440-C, are used as cathodes, and certain principal commercial electroplating processes are studied. The results prove that the absorption of hydrogen by the cathode is quite independent of the total amount of hydrogen deposited, such that all metal plating processes studied cause at least as much, and generally more, embrittlement than hydrogen plating itself, i. e., cathodic pickling. The results are particularly surprising in demonstrating such marked injury from baths with efficiencies closely approaching 100 per cent. Copper plating belongs with cadmium plating, and often even with chromium plating, as a factor deserving the closest consideration in plant failures that occur in such fabricating operations, for example, as wire drawing and cold-upsetting where copper plate is applied previous to coldworking. Similarly, problems of poor adhesion, blistering, and porosity in the plate itself should be carefully reviewed with regard to the often unsuspected scope of hydrogen activity demonstrated by this research.

A phenomenon in recovery of the plated articles is also observed in which all specimens at the end of a period of thirty-three months had recovered a 180-degree bend except the stainless steel having an acid-copper plate applied over a cyanide-copper strike, which showed very little recovery.

HYDROGEN EMBRITTLEMENT IN COPPER ELECTROPLATING*

C. A. ZAPFFE and M. E. HASLEM

Baltimore, Maryland

Introduction

Several years ago a specially designed bend test for measuring hydrogen embrittlement in steel wires was applied to a study of chromium and cadmium electroplating[1]. The results were somewhat unexpected, for each of these processes was found to cause greater damage to the wire than cathodic pickling, which is "plating" with hydrogen itself.

While chromium plating is commonly conceded to contribute hydrogen to a steel base, since a major proportion of the current is known to be spent in transferring hydrogen to the cathode, hydrogen problems with the more efficient processes become more subtle. The fact that severe embrittlement was detected in these tests with cadmium plating—even when current efficiencies were so high that very few hydrogen bubbles were observed to evolve—led to studies with other plating processes. Among the processes which are most commonly used, and which are generally believed to have cathode efficiencies closely approaching 100 per cent, are certain of the copper plating processes.

At least thirty years ago, embrittlement of steel after electroplating with copper was discussed[2,3]; and recent writers occasionally mention hydrogen embrittlement[4,5]. The present consensus, however, seems to be that hydrogen absorption is not particularly important in copper plating because of the commonly high current efficiencies and that in certain baths, such as that of the acid process, the problem is nonexistent because the efficiency attains virtually 100 per cent.

In its principal purposes, the present paper shall demonstrate that hydrogen is considerably more active in copper plating processes than is commonly believed, that injurious embrittlement of the steel base may develop even in the complete absence of visible hydrogen evolution, and that certain shop problems of low ductility of the steel and of porosity[6] and poor adhesion of the plate should be reexamined from the standpoint of the activities of this gas.

*From research conducted in the laboratory of the senior author under contract with the Office of Naval Research.

TABLE I. DESCRIPTION OF SPECIMENS

Designation	Analysis	Manufacture and Size
SAE 1020	C = 0.18 Mn = 0.60 Si = 0.17	No. 5-gage green rod drawn 6 holes to 0.062 inch dia. Ultimate tensile strength = 170,000 psi
AISI 440-C	Cr = 16.79 C = 1.01 S = 0.020 P = 0.021 Si = 0.49 Mn = 0.42 Ni = 0.23 Mo = 0.56	Annealed 1550° F for 3 hr, cooled 25°/½ hr to 1200° F, air cooled, and cold-drawn to 0.060 inch dia. with 24.5 per cent reduction of area

As a specific industrial aspect, this research should call the attention of fabricators employing a copper coating on material to be drawn, cold-headed, or cold-worked in any manner, to the fact that the ductility of certain steels is likely to be seriously reduced by the plating process.

Experimental Procedure

Plating Processes

Because of the great number of baths, processes, and addition agents now accumulated for this art[7], the present study is forcibly confined to a few processes selected on the basis of their importance to the industry and to the particular issues raised by the research.

Thus, the two major bath types—acid and cyanide—are compared, the Rochelle-salt and the high-speed types are studied, and the effects of several addition agents are noted. The research does not cover certain notable recent processes such as the fluoborate[8], pyrophosphate[9], alkane-sulfonic acid[10] baths, and so forth [11,12,13]. These are recommended for subsequent studies when a more thorough exploration is to be made of the issues raised by the present research, the principal purpose of which is to call attention to the phenomenon of hydrogen embrittlement in copper plating and to indicate the general outline of its surprising scope.

As each bath is discussed, its constitution will be given. Preparations and procedures for the standard baths generally followed the text, "Modern Electroplating"[14], whereas proprietary baths were prepared according to the directions of the manufacturer.

Specimens

For cathode material, both mild steel, SAE 1020, and stainless steel, AISI 440-C, were used in duplicate series of tests throughout the work, following the procedure adopted for the similar study of inhibitors in acid pickling[15]. The two steels are described in Table I.

Test Method

Details of the test method can be found in the previous paper[1]. Briefly, specimens in the form of duplicate 1/16-inch wires were cut about 4 inches long, cleaned carefully by hand-polishing with emery paper, and fastened between copper anodes and immersed 2 inches in the electrolyte. Except for the unconventional but uniform cleaning, all operations were conducted in a conventional manner[14]. The test was continued for the desired period of time, the wires were withdrawn, immediately rinsed, and immersed in ice water of 0° C (32° F) to delay changes in the condition of the wire with respect to hydrogen. At 30 seconds after cessation of plating, the first wire was subjected to the bend test, and at 90 seconds the duplicate was tested. This technique suppresses any error which might develop from aging before testing.

In all graphs which follow, the large circles represent the 30-second specimen and the small circles the duplicate 90-second specimen; the blackened circles refer to the mild steel, while the open circles refer to the stainless steel; shaded areas are used to designate the embrittlement caused by the test.

As for the bend test, its principal feature is the bending of the wire specimen at a constant rate of 5 degrees per second around a 1/16-inch radius placed at the center of the 2-inch plated length. The angle at which fracture occurs was recorded; it is measured along the ordinate in all following graphs, the plating time being measured along the abscissa. A bend of 180 degrees signifies that the wire did not break and that the ductility remained unimpaired so far as the sensitivity of the test can demonstrate.

Results

Establishing a Standard with Hydrogen, Chromium, and Cadmium Plating

To establish a basis for comparing the results of the present work with those previously obtained for cathodic pickling, chromium and cadmium plating, the standard tests described in the previous paper were repeated using the coils of the wire described in Table I. Mild steel had not been studied before, and the 440-C stainless steel used in the present work was from a new coil.

Hydrogen Plating

Test Conditions:

Electrolyte	10% H_2SO_4 in distilled water
Temperature	50° C (122° F)
Current density	15.5 amp/dm² (144 asf)

In Fig. 1 the plot of bend values shows that the SAE 1020 steel developed no measurable embrittlement from hydrogen plating over a period of more than one hour under the conditions of this test. The stainless steel, however, very rapidly developed embrittlement as shown by the uppermost of the lower family of three curves, the bend values falling after long charging periods to within a range near 40 degrees.

Accordingly, these data show the mild steel to be relatively resistant to hydrogen embrittlement and the stainless steel to be particularly sensitive. Because of its great sensitivity to hydrogen, Type 440-C stainless steel serves as an excellent criterion for hydrogen absorption. The principal value of the inclusion of mild steel in the tests, besides its broad usage in industry, is to emphasize the results soon to be discussed wherein embrittlement develops in this steel from certain copper plating processes in contrast to the lack of measurable damage from plating with hydrogen.

Cadmium Plating

Test Conditions:

Electrolyte	32 g/l cadmium oxide 75 g/l sodium cyanide 2 g/l gelatin
Temperature	50° C (122° F)
Current density	3.2 amp/dm² (30 asf)

In this test the electrolyte temperature was the same as in the preceding test, but the current density was much less. One might, therefore, expect reduced embrittlement—particularly in view of the fact that only a small percentage of this current is used for hydrogen deposition in this relatively efficient process.

To the marked contrary, the results in Fig. 1 show greater embrittlement developing in the stainless steel than from pure hydrogen plating, the bend values decreasing to a minimum near 30 degrees. The mild steel, however, remains unaffected.

Chromium Plating

Test Conditions:

Electrolyte	500 g/l CrO_3 3 ml/l H_2SO_4
Temperature	50° C (122° F)
Current density	15.5 amp/dm² (144 asf)

Before plating, the specimens were activated by reversing the polarity and anodizing for 2 minutes.

In the present test, both the temperature and the current density were the same as for hydrogen plating. Although the current efficiency is very low for chromium plating, the fact that the hydrogen deposition is necessarily less than in hydrogen plating would perhaps lead one to expect less embrittlement. The

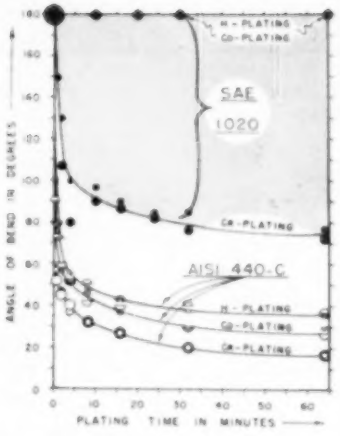

Fig. 1. Bend values for standard tests with hydrogen plating (cathodic pickling), cadmium plating, and chromium plating

contrary was again true, however, as with cadmium plating; and this time the embrittling propensity was so great that the mild steel was also immediately and importantly embrittled. The bend values for both steels are the lowest of all three groups described thus far, decreasing to less than 20 degrees for the stainless steel. As proved in the previous work[1], the embrittlement throughout the early portion of the curve is not to be attributed to brittle plate but to hydrogen absorption, for up through plating periods of perhaps 15 minutes the steel recovers a 180-degree bend on standing.

The tests illustrated in Fig. 1, therefore, provide a standard for comparing the subsequent results with copper plating. The curves for hydrogen plating are particularly significant as a standard, of course; and the results with metal plating then reveal the activity of a subtle surface phenomenon in which the codeposition of metal greatly increases the ability of hydrogen to dissolve in the steel. Plating processes, therefore, cannot be judged on the basis of current efficiency so far as possible damage from hydrogen absorption is concerned; instead the problem must be specifically and separately evaluated in each case.

Copper Plating from Acid Bath

Test Conditions:

Electrolyte	200 g/l $CuSO_4$ 37 g/l H_2SO_4
Temperature	50° C (122° F)
Current density	4.3 amp/dm² (40 asf)
Anode	Electrolytic copper

Because the acid bath for copper plating is an historic standard, and particularly because it is commonly regarded to have a current efficiency closely approaching 100 per cent, this process was studied first.

To separate the effect of the fundamental bath con-

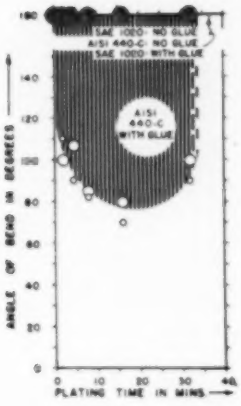

Fig. 2. Embrittling action of a standard acid-copper bath with and without glue addition

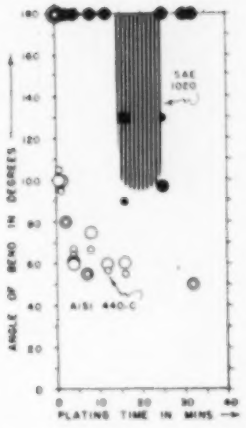

Fig. 3. Embrittling action of a standard cyanide-copper strike bath

stitution, if possible, from the effect of various "brighteners" and other reagents commonly added, tests were run with no additions. The plate did not adhere; and neither of the steels developed measurable embrittlement, as shown in Fig. 2.

When the series was repeated with an addition of 0.003 g/l of glue, an adherent plate resulted on all specimens and the stainless steel developed embrittlement as depicted in Fig. 2. The mild steel still showed no embrittlement. The data for the stainless steel possibly indicate a slight recovery after long plating periods, which would result from a decreased hydrogenizing activity as the plate thickened. Such an action is substantiated by later results with the mild steel where recovery during extended plating is the rule, but this is the only instance found for the stainless steel.

This embrittlement of the stainless steel is particularly interesting, because the tests, even if not conducted as perfectly as those for which some investigators have claimed virtually 100 per cent efficiency, came sufficiently close to that efficiency so that no gas bubbles were visible on the cathode even after a half-hour plating period. The embrittlement, therefore, is a phenomenon which involves an extremely subtle activity of small quantities of hydrogen and does not depend on visible gas evolution.

Before considering the common commercial process in which the acid-copper plate is applied to ware first given a "strike" coating in another bath, we shall study the effect of the strike bath itself.

Flash Plating from Cyanide-Copper Bath

Test Conditions:

Electrolyte	19.6 g/l $CuCO_3$ 31 g/l NaCN
Temperature	30° C (86° F)
Current density	3.8 amp/dm² (35 asf)
Anode	Electrolytic copper

Although this process is used commercially only for producing a "strike" coating, a prolonged series of standard tests was run to determine the hydrogenizing propensity of the process.

The data in Fig. 3 reveal a rapid and serious embrittlement of the stainless steel and even an embrittlement of the mild steel after long plating periods. The conventional strike plate of only 30 seconds' duration already succeeds in causing the stainless steel to break at an angle near 100 degrees of bend. Note the subsequent recovery of the mild steel on prolonged plating, which does not occur with the stainless steel. The efficiency of this strike bath is relatively low[14]; nevertheless, it is surprising to find it more powerfully hydrogenizing to the steel than cathodic pickling.

Acid-Copper Plating Over Cyanide-Copper Strike

Returning now to the common commercial process of plating from an acid bath on ware first given a flash coating from a cyanide bath, we observe in Fig. 4 the contributions of hydrogen both from the strike and from the subsequent plate. The mild steel is neither embrittled by the 30-second strike nor by the subsequent plate, but the stainless steel, with bend value reduced to 100-105 degrees by the 30-second strike, is further embrittled by the acid-copper plate as indicated by the cross-hatching.

Copper Plating from Rochelle-Salt Bath

Test Conditions:

Electrolyte	34.2 g/l $CuCO_3 \cdot Cu(OH)_2$ 49.5 g/l NaCN 14.5 g/l Na_2CO_3 45 g/l Rochelle salt ($KNaC_4H_4O_6 \cdot 4H_2O$)
Temperature	50° C (122° F)

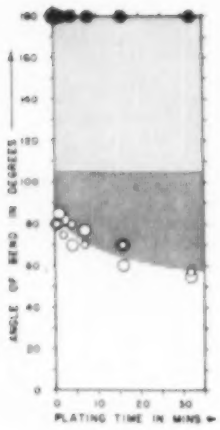

Fig. 4. Embrittling action of acid-copper plating applied to specimen first given a 30-second cyanide-copper strike

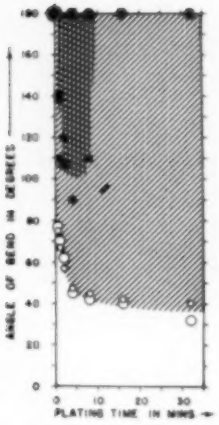

Fig. 5. Embrittling action of a Rochelle-salt copper bath

Current density	3.8 amp/dm² (35 asf)
Anode	Electrolytic copper

In Fig. 5, the bend values disclose a marked embrittlement of both the mild and the stainless steel. Embrittlement sets in immediately, causing injury comparable to that from chromium plating (see Fig. 1) and considerably greater to mild steel than that from any of the copper plating processes yet discussed. This is consistent with the mediocre efficiency of this bath, which commonly varies between 30 and 60 per cent[14].

On prolonged plating, the mild steel recovers but the stainless steel does not. This contrast between the two grades of steel is consistently demonstrated in later tests.

A second series of tests was run with the stainless steel wire using a bath of the same constitution but composed as follows:

CuCN	26 g/l
NaCN	33 g/l
Na_2CO_3	30 g/l
Rochelle salt	varied as shown in Table II

Plating conditions were the same as in the previous tests, except that the concentration of Rochelle salt was varied as shown in Table II to determine what effect, if any, might follow from the different concentrations of that constituent used from plant to plant. The results were negative.

High-Speed Cyanide-Copper Plating

SODIUM-TYPE BATH WITH NO ADDITION

Test Conditions:

Electrolyte	120 g/l CuCN 135 g/l NaCN 30 g/l NaOH
Temperature	80° C (176° F)
Current density	3.8 amp/dm² (35 asf)
Anode	Electrolytic copper
Solution agitation	

First, a series of tests was run with no addition agent. The results in Fig. 6 show severe embrittlement, even the mild steel fracturing within a short time of plating. As usual, the mild steel recovers on prolonged plating, but the stainless steel does not.

While the embrittlement here is more severe than

TABLE II. EFFECT OF CONCENTRATION OF ROCHELLE SALT ON EMBRITTLEMENT OF STAINLESS STEEL

Plating Time minutes	Max. Bend Values in Degrees at Rochelle Salt Contents of		
	30 g/l	45 g/l	60 g/l
6	45, 47	45, 45	40, 47
12	42, 47	45, 42	40, 45

TABLE III. EFFECTS OF AGITATION AND SODIUM THIOSULFATE CONCENTRATION ON EMBRITTLEMENT OF STAINLESS STEEL

Plating Time minutes	Max. Bend Values in Degrees at Sodium Thiosulfate Contents of		
	10 g/l	15 g/l	20 g/l
12	40, 35	37, 37	40, 47
15	35, 37	40, 40	32, 40
20	32, 35	32, 40	40, 40

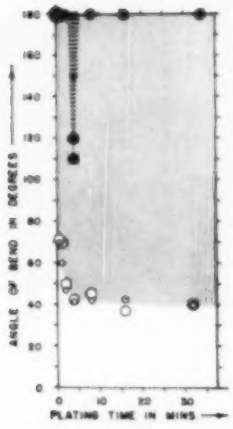

Fig. 6. Embrittling action of a sodium-type high-speed cyanide-copper bath with no addition agent

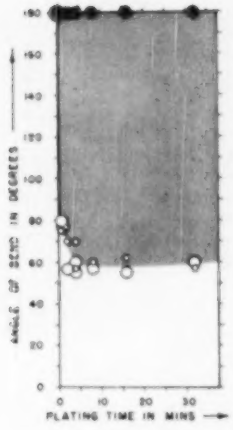

Fig. 7. Embrittling action of an agitated sodium-type high-speed cyanide-copper bath containing sodium thiosulfate as an addition agent

that resulting from 100 per cent hydrogen plating (in Fig. 1), the temperature is also 30° C (54° F) higher, which is known to lead to greater embrittlement[16].

Sodium-Type Bath with Added Sodium Thiosulfate

The bath just given being used, the tests were repeated with an addition of 15 g/l of sodium thiosulfate. The results, shown in Fig. 7, indicate a slight improvement in ductility in the presence of this reagent. No embrittlement of the mild steel is now found at any plating period, and the minimum bend angle for the stainless steel is raised from a range near 40 degrees to approximately 60 degrees.

Effect of Agitation

To study the effect of agitation, which is known to be an important factor in the surface chemistry of these high-speed processes, the foregoing tests were repeated in a quiescent solution. The concentration of addition agent was also varied to determine whether concentration is a factor. Table III lists the results.

The data in this table disclose that the addition agent, over the concentration range studied, acts uniformly with respect to hydrogen absorption. The bend values average less than 40 degrees, often falling as low as 32 degrees, as compared to about 60 degrees for the agitated bath in Fig. 7; in fact, the bend values for the quiescent bath are at least as low as those shown in Fig. 6 for agitated baths with no reagent added.

Effect of Copper Cyanide Concentration

To study the effect of the concentration of copper cyanide, the listed bath (no addition agent) was used in three series of tests with all concentrations fixed except that of the copper cyanide. The results, in Table IV, show no significant change from the normal concentration of 120 g/l down to 90 g/l; however, when the concentration is increased to 150 g/l, the plate becomes nonadherent and no embrittlement results.

Effect of Sodium Cyanide Concentration

In Table V, results from similar tests with varied sodium cyanide concentration show that an increase from the normal 135 g/l up to 170 g/l effects only a slight decrease in bend value, if any, whereas a de-

TABLE IV. EFFECT OF COPPER CYANIDE CONCENTRATION ON EMBRITTLEMENT OF STAINLESS STEEL

Plating Time minutes	Max. Bend Values in Degrees at Copper Cyanide Contents of		
	90 g/l	120 g/l	150 g/l
6	50, 45	45, 40	180, 180*
12	45, 40	45, 42	180, 180*

*Nonadherent coating.

TABLE V. EFFECT OF CONCENTRATION OF SODIUM CYANIDE ON EMBRITTLEMENT OF STAINLESS STEEL

Plating Time minutes	Max. Bend Values in Degrees at Sodium Cyanide Contents of		
	100 g/l	135 g/l	170 g/l
6	180, 180*	45, 40	40, 45
12	180, 180*	45, 42	37, 40

*Nonadherent coating.

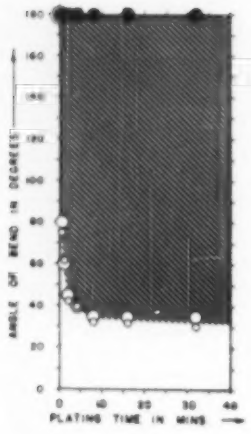

Fig. 8. Embrittling action of du Pont sodium-type Hi-Speed cyanide-copper bath

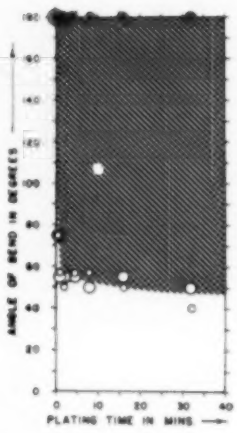

Fig. 9. Embrittling action of du Pont potassium type Hi-Speed cyanide-copper bath

crease in concentration to 100 g/l results in a nonadherent coating and no embrittlement.

DU PONT SODIUM-TYPE HIGH-SPEED BATH
Test Conditions:

Electrolyte	269 g/l Hi-Speed Salts 41.8 g/l KOH 0.935 g/l Addition Agent No. 556 1.87 g/l Addition Agent No. 774
Temperature	80° C (176° F)
Current density	3.8 amp/dm² (35 asf)
Anode	Electrolytic copper
Solution agitation	

The bend values for this proprietary bath are shown in Fig. 8. It is interesting that the mild steel is not embrittled, for the stainless steel indicates this bath to be a markedly embrittling one. The minimum values close to 30 degrees of bend are as low as any yet found.

DU PONT POTASSIUM-TYPE HIGH-SPEED BATH
Test Conditions:

Electrolyte	180 g/l Hi-Speed Salt 42 g/l KOH 2.4 g/l Addition Agent No. RH 774
Temperature	80° C (176° F)
Current density	3.8 amp/dm² (35 asf)
Anode	Electrolytic copper
Solution agitation	

The data in Fig. 9 show no embrittlement of mild steel but marked embrittlement of stainless steel. Comparison with the foregoing Fig. 8 shows the potassium bath to be somewhat less injurious than the sodium bath so far as hydrogen embrittlement is concerned.

Promat Prosalt Copper Bath

In closing this introductory study, one other proprietary bath is selected to show the generality of the hydrogen effect in all these baths. Promat Prosalt is a modified Rochelle-salt bath.
Test Conditions:

Electrolyte	26.2 g/l CuCN 34.4 g/l NaCN 29.9 g/l Na_2CO_3 34.3 ml/l Prosalt
Temperature	60° C (140° F)
Current density	3.8 amp/dm² (35 asf)
Anode	Electrolytic copper

In Fig. 10, the bend values disclose this bath to be strongly embrittling though slightly less so than the standard Rochelle-salt bath of Fig. 5. Both the mild steel and the stainless steel become embrittled. The mild steel then rapidly recovers during the longer plating periods, while the stainless steel continues to lose ductility, attaining a record minimum of less than 30 degrees of bend, though perhaps later recovering somewhat.

AN OBSERVATION ON AGING OF COPPER PLATED SPECIMENS

Since specimens from these tests were still available at the time this manuscript was being prepared, 33 months after the plating operations, their bend values were redetermined to discover the effect of that period of aging under normal conditions of room temperature. Only the stainless steels were examined, and the specimens with the heaviest coating were selected. The results are listed in Table VI.

Certainly these results are surprising, for the speci-

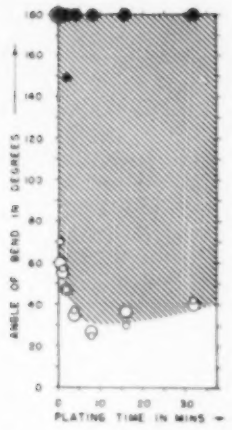

Fig. 10. Embrittling action of Promat Prosalt proprietary copper bath

TABLE VI. EFFECT OF 33 MONTHS' AGING AT ROOM TEMPERATURE ON THE BEND VALUES OF TYPE 440-C STAINLESS STEEL WITH A 32-MINUTE PLATE

Process	Angle of Bend degrees
Acid, with glue	180, 120
Cyanide strike	180, 180
Acid on cyanide strike	77, 70
Rochelle salt	130, 180
Sodium-type high-speed cyanide, no addition	180, 180
Sodium-type high-speed cyanide with $Na_2S_2O_3$	180, 180
du Pont Sodium-type Hi-speed cyanide	180, 180
du Pont Potassium-type Hi-speed cyanide	180, 180
Promat Prosalt cyanide	180, 180

ments plated by the widely used commercial acid process have not recovered their ductility after nearly three years of aging at ordinary temperatures. Some brittleness also remains in the steel plated in the standard Rochelle-salt bath, but all other specimens have recovered as one would most logically expect from the general knowledge of hydrogen behavior. Even with the 32-minute plate, the specimens from the cyanide strike bath recover, but those given an acid copper plate over the cyanide-copper strike show scarcely any improvement at all. The latter, in turn, should be compared with the acid-copper plated specimens produced with a glue addition instead of a cyanide strike, which recover to a much greater extent.

No explanation is at hand for these results, although one is reminded of the interesting recent work on pickling by Rosenfeld[17] who claims that the conditions under which hydrogen is supplied to steel can strongly affect its rate of removal.

Conclusion

The principal importance of the present study lies in its disclosure of the surprising scope of hydrogen activity in steel electroplated with copper, even by processes the efficiency of which is so high that no visible gas evolution is observed at the cathode. The common tendency to disregard hydrogen as a source of important problems in plant procedures employing copper plating processes of ultra-high efficiency is shown by this research to be in error.

In the present tests, the gas absorption is measured by its effect on ductility as disclosed by the bend test. However, one should also recognize the significance of the results with regard to problems of poor adhesion, blistering, and porosity in the plate, and particularly with regard to failures in fabricating operations, such as wire drawing and cold-heading, where the steel is often surfaced with copper plate.

As for the specific disclosures of the research, these can be summarized as follows:

1. Most copper plating processes are similar to cadmium and chromium plating processes in that they cause greater embrittlement of a steel cathode than does straight hydrogen plating (cathodic pickling).

2. The embrittling effect developed by electroplating is virtually independent of the amount of hydrogen carried to the cathode, to the far extent that some processes developing no visible cathodic gassing whatsoever cause the greatest embrittlement, considerably exceeding the effect of straight hydrogen plating.

3. The matter of hydrogen absorption by the cathode is therefore one of subtle surface chemistry, and it is an error to judge the hydrogenizing propensity of any electrolytic process without a specific measurement having been made.

4. Processes which do not produce adherent coatings also do not produce embrittlement, and reagents which are added to baths to change the characteristics of the plate also change the characteristics of embrittlement, such that each condition requires separate evaluation.

5. All baths studied, immediately and markedly embrittle the hardenable Type 440-C stainless steel even though it be in the annealed-coldworked condition, whereas mild steel, SAE 1020, in a similar condition, is only occasionally embrittled sufficiently to register in the bend test.

6. All processes studied reduce the bend value for Type 440-C even in early plating periods from its original full bend of 180 degrees down to at least 80 degrees, and in some cases to values less than 30 degrees.

7. A 30-second flash coating in a cyanide solution already reduces the bend value for Type 440-C stainless steel toward 100 degrees, and a subsequent acid-

(Continued on page 972)

F. K. SAVAGE

FRANK K. SAVAGE is an outstanding member of that relatively new fraternity of platers, the plating engineers, who within the last couple of decades have brought order out of chaos and changed practical plating from day-by-day experimentation to controlled operation.

Born in Marcellus, Mich., on May 24, 1909 of Irish-Pennsylvania Dutch lineage, he received his secondary and college-preparatory education in nearby Decatur. His alma mater is Michigan State College, where he specialized in electrochemistry and industrial chemistry under Professors Ewing and Reed. He received a B.S. degree in Chemical Engineering in 1935, and the professional degree of Chemical Engineer in 1941 with a thesis on "The Modernization of a Plating Room".

In the fall of 1935 he joined C. G. Conn, Ltd., Elkhart, Ind., and rose from Chemist to General Superintendent. Here he developed new methods for the manufacture of many band instruments by electroforming and for full automatic silver plating, some of which he recorded in the technical literature.

Between February, 1946 and August, 1947 he was Superintendent of the Metal Division of Kuehne Manufacturing Company, Mattoon, Ill., where he designed and put into operation the metal-furniture plating plant recently described in "Plating".

After a short period with Standard Plating Rack Company of Chicago, he now splits his time between his own company, Star Silver Plating Company of Kalamazoo, Mich., and consulting activities with Graham, Crowley and Associates, Inc., Chicago. He is a Vice-President of the latter organization.

Mr. Savage has been a very active member of two technical societies, American Electroplaters' Society and American Society for Testing Materials. He served the former as a member of its Research Committee for several terms beginning in 1937 and as Chairman of two Research Project Committees, Nos. 1 and 5, between 1944 and 1946. He was President of its Chicago Branch in 1942-1943, and became a member of the Society's Executive Board in 1944 and its President during the year 1946-1947. His services in A. S. T. M. include the chairmanship of Subcommittee IV of Committee B-8 on Electrodeposited Metallic Coatings.

Perhaps Mr. Savage's greatest influence has been felt through the many papers that he presented at A. E. S. conventions and branch meetings and through his articles in the technical press. Beside the subjects already mentioned he has dealt with such topics as gold and silver recovery, alkaline cleaners and wetting agents, useful applications of bipolarity, anode and cathode phenomena during plating, and wage incentives in the plating room, all in an exceedingly practical and down-to-earth manner.

Among honors that have come his way are the A. E. S. Gold Medal in 1942 and the same society's Founders' Gold Medal in 1944. He is also a member of Alpha Chi Sigma, National professional chemical fraternity.

Mr. Savage now lives with his wife and three sons in Kalamazoo, Mich., only a short distance from his birthplace. One of his hobbies is color photography; another fishing, preferably in the wilds of Canada and, since past summer, with his oldest son, Kem.

This second and final installment of Mr. Kushner's article shows the enormous savings in rinse water that can be accomplished by means of multiple-, even double-, compartment rinse tanks with improvement of rinsing efficiency.

Attention should be given to the suggestion that single rinse tanks in their usual sequence with other tanks be hooked together and operated as multiple-compartment tanks. The danger of contamination of earlier tanks by the contents of later tanks in the sequence, however, limits the applicability of the method.

Rinsing

II. WITH MULTIPLE-COMPARTMENT TANK

JOSEPH B. KUSHNER

Metal Finishing Consultant, Stroudsburg, Pennsylvania

IT WAS SHOWN in Part I of this paper that the limiting or equilibrium concentration of an ion or salt regularly carried into a single-compartment rinse tank by drag-in, is given by the expression

$$C_i = C_o \Phi n \left(\frac{V - Q}{VQ} \right) \qquad (2)$$

where C_i = limiting concentration of the ion or salt, in oz/gal
C_o = concentration of the ion in the drag-in, in oz/gal
Φ = volume of the drag-in, in gallon per sq. ft. of surface
n = number of sq. ft. of surface dipped per minute
V = volume of the rinse tank, in gallons
Q = rinse water flow rate, in gallons per minute (gpm)

Based on this equation it was also shown that the flow rate, Q, required to keep a given ion from building up to a dangerous level, C_d, in the rinse tank, is given by the expression

$$Q = \frac{V}{1 + \dfrac{VC_d}{\Phi n C_o}} \qquad (4)$$

A mutual rinse tank of the single-compartment type, serving a Rochelle copper tank and an acid dip prior to a bright nickel tank, as shown in the schematic layout (Fig. 3), was considered under the following conditions of operation: C_d = 0.002 oz/gal copper in nickel bath, C_o = 4 oz/gal copper in Rochelle bath, V = 100 gal, Φ = 0.01 gal/sq. ft., n = 2 sq. ft./min. Per equation (4) the flow rate, Q, had to be 28.5 gpm, a relatively high and expensive value, in order that the dangerous concentration, C_d, be not exceeded.

What will happen if the shop owner inserts *a second rinse tank* of volume V between the acid dip and the bright nickel to provide a straight line operation? Off hand it would seem that the water bill would become higher, and that is so in most cases where no control is exercised. What happens is that the owner tells the plumber to run in a ¼-inch line, the operator turns open the valve, and the water bill goes up! For this reason many owners skimp on the number of rinse

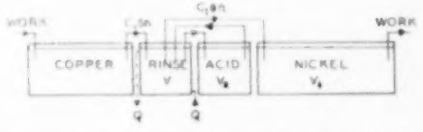

Fig. 3. Part of a layout, with a mutual single-compartment rinse tank serving both a copper cyanide and an acid tank

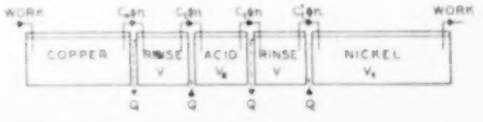

Fig. 4. Part of a layout, with single-compartment rinse tanks serving the copper cyanide and the acid tank

tanks in order to save water; yet an analysis will show that the use of an additional rinse tank not only will give better rinsing but also can save on the water bill as well, by a goodly percentage.

Consider this case as it presents itself in Fig. 4.

The copper ion concentration will soon reach the equilibrium value C_1 in the first rinse tank, which value is given by equation (2). It also enters the acid dip, of volume V_a, where it at any given time, t, reaches the value C_a.

$$C_a = C_o \Phi n \left(\frac{V - Q}{VQ}\right)\left[1 - \left(1 - \frac{\Phi n}{V_a}\right)^t\right]$$

Since the factor in the brackets becomes practically equal to unity after a period of operation, the copper concentration in the acid dip ultimately also reaches the value C_1.

In the second rinse tank, of volume V', the new equilibrium value C_1' will be

$$C_1' = C_1 \Phi n \left(\frac{V' - Q'}{V'Q'}\right) \qquad (8)$$

Inserting the value for C_1 from equation (2) we obtain

$$C_1' = C_o (\Phi n)^2 \left(\frac{V - Q}{VQ}\right)\left(\frac{V' - Q'}{V'Q'}\right) \qquad (9)$$

If we make $V = V'$ and use the same rate of flow of rinse water in each tank, Q gpm, i. e., $Q = Q'$, then the total amount of water used will be $2Q$ and the equilibrium concentration of the copper ion in the second rinse tank will be

$$C_1' = C_o (\Phi n)^2 \left(\frac{V - Q}{VQ}\right)^2 \qquad (10)$$

If this equation is solved for the value of Q that will keep the ion concentration from reaching the dangerous level C_d in the second rinse tank, we obtain

$$Q = \frac{V}{1 + \frac{V}{\Phi n}\sqrt{\frac{C_d}{C_o}}} \qquad (11)$$

Note that this equation has the same form as equation (4) except that it contains the square root of the ratio C_d/C_o instead of the ratio itself.

Using the same values of C_d, C_o, V, Φ and n as before, which with one rinse tank resulted in a minimum flow rate of 28.5 gallons, let us see what rinse water flow is needed in each tank to keep the copper ion concentration from reaching the dangerous level. Substituting into equation 11, we find that now Q = 0.89 gpm! If for round figures we make it 1 gpm, then a total of $2Q$ or 2 gpm will be used. This amounts to a saving in the water supply of $100 \times (28.5-2)/28.5 = 93$ per cent.

However, such a saving cannot be realized unless there is some means for measuring and controlling the flow of water to each tank. Such a means in the simplest form can consist of an inexpensive Rotameter and a manually operated valve in the feed line. It is therefore practicable, according to these figures, to get better rinsing with two rinse tanks, for less money!

The same principle will hold where single compartment rinses are used in an automatic plating line. Consider, for example, the case in which each rinse tank holds $V = 200$ gallons and the copper concentration C_o of the Rochelle bath is 4 oz/gal as before. If a cup shaped article is being plated with a dragout $\Phi = 0.02$ gal/sq.ft. and $n = 20$ sq.ft. of surface are being dipped per minute, then by substitution in equation (11) we obtain $Q = 18$ gpm. That means a total of 36 gpm will have to be used. Where use of deionized water is being contemplated in a case like this, a plot will have to be made as shown in Part I in order that the total expense be kept at a minimum.

Let us now consider the *double-compartment rinse tank* shown diagramatically in Fig. 5. In operation, the

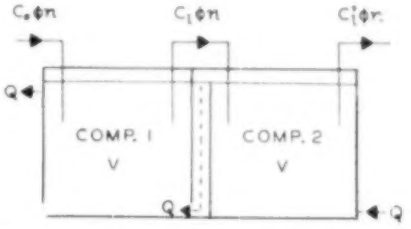

Fig. 5. Conditions existing in a double compartment rinse tank

work from the contaminating tank is dipped into the first compartment to remove the bulk of contaminant, then dipped into the second compartment with the cleanest water. This is known as countercurrent rinsing. It will be remembered from the discussion of the two separate rinses that the intervening acid dip tank only delayed reaching the limiting concentration C_1 in the second rinse tank. The only difference then between two independent consecutive rinse tanks and the double-compartment rinse tank is that the same water that enters the second compartment flows in the first before being discarded. In the double-compartment tank a small fraction of what has been rinsed off in the first tank gets into the second tank by dragin and a fraction of that is fed back to the first tank, but the latter effect is so small that the limiting concentration of an ion or substance C_1 in the second compartment for all practical purposes is the same as that given by equations (9) or (10).

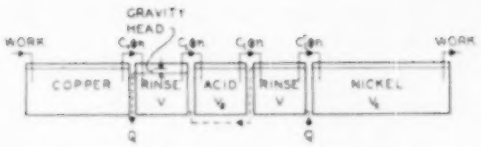

Fig. 6. Part of a layout, with a "long-distance" double-compartment rinse serving the copper cyanide and the acid tank

The striking fact is that the double-compartment rinse tank accomplishes substantially the same result with ½ the amount of water as two separate rinse tanks with their individual water supplies!

In equation (10) we arbitrarily made $Q = Q'$ and $V = V'$. In the case of the double-compartment rinse tank the interesting question arises: would there be any advantage in making one compartment larger than the other? It can be readily shown that, for any total tank size, the most effective rinsing takes place when the tank is divided exactly in half so that each compartment is of the same size.*

An important point which should be emphasized, judging from some rinsing operations witnessed by this author, is that reverse-order rinsing, i. e., going from compartment 2 to compartment 1, completely invalidates a double-compartment rinse-tank function. Such rinsing is nothing but a double immersion in the same rinse tank.

Now let us see what happens in the case of the automatic plating machine if we use *two double-compartment rinses* instead of the two single-compartment rinses. The same reasoning is used as in the development of equation (10), and the new value of the limiting concentration, C''_1, is given by the equation

$$C''_1 = C_a\,(\Phi n)^4 \left(\frac{V - Q}{VQ}\right)^4 \qquad (12)$$

If this equation is solved for Q, we obtain for $C_d \leq C''_1$

$$Q = \frac{V}{1 + \dfrac{V}{\Phi n} \sqrt[4]{\dfrac{C_d}{C_a}}} \qquad (13)$$

which has the same form as equations (4) and (11) except that it contains the fourth root of the ratio C_d/C_a. Inserting $V = 200$, $\Phi = 0.02$, $n = 20$, $C_d = 0.002$ and $C_a = 4$, we obtain a value of $Q = 2.6$ gpm. With two such rinses, the total amount of water used will be 5.2 gpm and the saving, over the 36 gpm required with two single-compartment rinses, will be $100 \times (36 - 5.2)/36 = 85.5$ per cent.

In an automatic plating machine it may be too expensive to build with two double-compartment rinses; the machine will have to be lengthened and additional transfers installed. However, with only two single-compartment rinse tanks there is no reason why the same water that is led into the second rinse tank cannot be overflowed and led, by means of a pipe, into the first rinse tank! Such an arrangement would provide a "*long-distance*" *double-compartment rinse tank* and make it possible to cut the water bill in half. Calculation will show that gravity will be sufficient to keep the water flowing into the first "compartment" at the desired rate of 18 gpm if the water level in the second "compartment" tank is a few inches above the water level in the first "compartment". All that is required are pipe and fittings properly placed (Fig. 6).

The same kind of engineering can be applied to semi-automatic and manual set-ups. There is no reason why rinse water cannot be fed back to lower the water bill or to make possible the economical use of deionized water. A total difference in level of 1 foot should be enough to keep a series of up to five rinse tanks in a line, such as shown in Fig. 7, flowing with 2 or 3 gpm, making it possible to use the water five times before discarding it! Where such difference in level cannot be used, as many tanks as possible should be hooked up in series or, if costs warrant it, small pumps may be employed to maintain the flow with a reasonable drop in level. Such a procedure is definitely desirable where deionized water is used and in areas of the country, such as the West, where water is scarce.

In conclusion, one or two additional points about rinsing operations may be of interest. One pertinent question is, what happens in a rinse tank when work is rinsed at regular though infrequent intervals, for example, every 15 or 20 minutes?

In a case such as that, the equations derived in Part I still hold except that Q, the rate of water flow in gpm, now must be multiplied by a factor p which is the time period in minutes between rinsing operations.

Fig. 7. Part of a layout, with a "long distance" quadruple-compartment rinse tank serving four processing tanks. Note gravity feed of rinse water from tank to tank

*This can easily be demonstrated by setting $V' = V_t - V$ in equation (9), where V_t is the constant total volume, differentiating C'_1 with respect to V (C_a, Φ, n, and Q being constants), setting the differential equal to zero, and solving the resultant equation for V. The result is $V_t - 2V = 0$, or $V = \frac{1}{2} V_t = V'$.

For example, equation (2) for limiting concentration becomes

$$C_1 = C_0\,\Phi n\left(\frac{V-pQ}{VpQ}\right) \qquad (14)$$

In a specific instance, work with an average dragout of 0.2 gallon per load ($\Phi n = 0.2$) is rinsed every 15 minutes in a 100-gallon rinse tank in which water is flowing at a rate of 1 gpm. It comes from an acid dip in which the concentration of acid is 10 oz/gal. The equilibrium concentration C_1 of acid in the rinse tank is then

$$C_1 = 10 \times 0.2\,(100 - 15 \times 1)/(100 \times 15 \times 1) = 0.113 \text{ oz/gal}$$

If it is desired to keep the acid concentration in this rinse tank at a value no greater than 0.01 oz/gal, the required flow rate Q may be calculated by means of equation (4) similarly modified:

$$15\,Q = 100/\left(1 + \frac{100 \times 0.01}{10 \times 0.2}\right) = 66.7$$

and

$$Q = 4.44 \text{ gpm}$$

A further extension of this case is where not only the rinsing is infrequent but the water flow rate is excessively high. Here the equilibrium equation (14) breaks down, and in order to learn what the limiting concentration in the rinse tank will be, we have to resort to a less simplified equation easily derived from one of the expressions in the mathematical appendix of Part I:

$$C_1 = C_0\,\Phi n\left(\frac{e^{-Q/V}}{1 - e^{-Q/V}}\right) \qquad (15)$$

and, inserting pQ for Q,

$$C_1 = C_0\,\Phi n\left(\frac{e^{-pQ/V}}{1 - e^{-pQ/V}}\right) \qquad (16)$$

(It is evident that when pQ is of the same order of magnitude as V, $e^{-pQ/V}$ cannot be set equal to $1 - pQ/V$.)

The limiting value C_1 must now be calculated from equation (16), using an exponential table.

With pQ considerably in excess of V, which is possible when the rinse tank is small, $1 - e^{-pQ/V}$ approaches unity and equation (16) can be simplified to

$$C_1 = C_0\,\Phi n e^{-pQ/V} \qquad (17)$$

As an example of the latter situation, suppose that the average drag-out per load Φn is 0.2 gal as before, the interval p between rinses is 20 minutes, the volume of the rinse tank V is 25 gallons, and the water flow Q is 4 gpm. Then

$$C_1 = 10 \times 0.2 \times e^{-20 \times 4/25} = 0.08 \text{ oz/gal acid}$$

($e^{-3.2} = 0.04$ from an exponential table.)

A practice resorted to in job shops when rinsing is infrequent though regular is to shut off the rinse water between rinsing operations in an effort to save water. From the standpoint of preventing contamination of subsequent baths this is "penny wise, pound foolish". Calculations based on the equations given show that *the same total volume of water must be used daily* in order to keep the concentration of a harmful ion in the rinse tank at a desired level, regardless of whether the rinse water flows *continuously* at a *low* rate or *intermittently* at a *high* rate. It is, therefore, a waste of time and effort to turn the water on and off, and the water bill may actually become higher because of the possibility of forgetting to shut off the water.

Finally, in order to save water, to permit the most economical use of deionized water, and to promote the most efficient rinsing*, consideration should be given to the use of triple- and quadruple-compartment rinse tanks. For the triple-compartment tanks, a cube root replaces the square root in equation (11), and for the quadruple-compartment tanks, a fourth root is found as in equation (13), greatly reducing the required water flow Q. Some of the haphazardly engineered single- and double-compartment rinse tanks observed by the writer in many plating shops can be readily converted to highly efficient triple- and quadruple-compartment tanks with a tremendous saving in the water bill.

To *summarize the findings* about rinsing:

1. Avoid mutual rinse tanks to prevent contamination.
2. Use double-compartment rinse tanks in preference to single-compartment tanks wherever possible. Use triple- and quadruple-compartment tanks for even greater water savings.
3. In a given double-compartment rinse tank make each compartment of the same volume.
4. Make the compartments as small as possible compatible with easy handling of the largest contemplated object or rack that is to be rinsed.
5. Wherever possible connect rinse tanks in series with the clean water entering at the end of the plating cycle and leaving at the beginning of the cycle, using either gravity flow or pumps as conditions warrant.
6. Compute the proper rinse-water flow by means of the equations given, using constants that pertain to the particular case.
7. Use flow meters, such as Rotameters, and valves to maintain and control the desired water flow.

*The *"rinsing efficiency" R* of a given rinse tank may be defined, at equilibrium, as the percentage of dissolved material on the work that is removed by the tank:

$$R = 100\,\Phi n C_0 - \Phi n C_1)/\Phi n C_0 \quad \text{or} \quad R = 100\,C_0 - C_1)/C_0$$

WATER POLLUTION FROM ELECTROPLATING OPERATIONS

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Consultant, Industrial Health, Hygiene and Safety Service, Detroit, Michigan

THERE ARE PRINCIPALLY two sources of pollution resulting from electroplating operations, namely (1) solutions and (2) mists, gases and vapors.

The methods of air dilution advocated by some industrial hygienists are not always applicable. Considerable investigation of various methods of trapping chemical substances from the air has shown that the ideal methods of collection for most substances are wet methods.

Some ways of using wet methods are cheaper and far superior to any other means. By the use of combinations of impingement, atomization and scrubbing, we have been able to solve problems involving gases, as well as particles in the size range of 0.1 micron, with efficiencies ranging from 90 to 95 per cent and at costs approximately half of those involved in various commercially available pieces of equipment. This is in part because of the fact that commercial equipment is designed for all jobs and a premium for inefficiency is the result. In addition, some chemical substances are not easily collectible and then special equipment has to be designed for the specific job under consideration. For plating, we have used high-pressure sprays in various combinations and have found that the pressures required, as well as the amounts of water or other liquids consumed, can be kept within economical limits.

By the use of wet methods for mists, gases and vapors, there remain to be disposed only solutions. Generally speaking the problems that the electroplaters face are quite minor as compared to those of many other industries. There are a number of reasons for this: (1) the volume of chemical discharge is relatively small compared to that in such operations as pickling of steel; (2) the concentration of the solutions is usually quite low; (3) the chemicals to be disposed of can be handled fairly readily; and, (4) the diversity of operations in many electroplating shops are such as to provide a balance between alkaline and acid substances which, properly scheduled and disposed of, reduce the problems involved to considerable extent.

The usage of acid by platers is quite low and can in no way be compared with that found in steel pickling operations which involve huge volumes of low-percentage sulfuric acids. The latter operations do require reduction of acidity, and perhaps both acidity and ferrous salts content because of the extremely high immediate oxygen demand placed on the stream load by ferrous salts.

It should be pointed out that where treatment is required, the bringing together of various kinds of waste, properly chosen, can ameliorate conditions satisfactorily. For instance, pickling wastes require, in one type of treatment, the use of lime and simple aeration. If the pickling people would look around, they would find various places where they could have lime for merely hauling it away. Thus lime is a waste product in many acetylene manufacturing plants.

This example is important because it emphasizes a fundamental point which should always be considered in the electroplaters' disposal of waste: that the proper chemical balance of waste products can result in an acceptable waste. And one does not always have to go to different industries to collect a suitable wastes mixture that will arrive at sewage treatment points as a relatively easily handled material.

The complete finishing of metals by electroplating may include (1) polishing of the base metals, (2) cleaning by solvents and alkaline solutions, (3) pickling by acids, (4) metal disposition, (5) buffing of the deposits, and (6) lacquering. All know that the polishing and buffing operations, the lacquering operation, as well as any grinding operation that may have to be done, all produce solids which can be carried to dumps for disposal. That is certainly a reasonable means for the foreseeable future as long as atomic wastes are being disposed by that method.

In passing, practically any substance has value if that value can be found; in a properly balanced use of materials, there should be no waste of any sort to be removed.

At any rate, the problems remaining to the electroplater concern the disposal of (1) solvents and alkaline solutions used in cleaning, (2) acids used in pickling, and (3) chemicals used in the plating baths.

Alkalis and Acids

In shops which use alkaline cleaning solution, the balance between the acids from the pickling operations (sulfuric, hydrochloric, phosphoric, hydrofluoric and other acids) and the alkali cleaners (containing caustic soda, soda ash, trisodium phosphate and other phosphates, as well as smaller amounts of other sodium salts, soaps, and wetting agents) may be made such as to produce a substantially neutral effluent. This may require proper and judicious scheduling, under rigorous control, of the different waste solutions. It may even be better to provide a waste tank for alkaline and acid liquids which are released to the sewer system only at such times as neutrality has been achieved.

It should be emphasized that we are not here discussing the plating baths, some of which contain cyanides; the plating baths should be considered in a separate category, with one or two exceptions. The outstanding exception is that where alkaline waste exceeds the acid waste and where some oxidation may be demanded, the chromic acid waste may be used to supply such deficiencies. An instance would be where there are alkaline tin solutions. These are strongly alkaline and need an excess of oxidant to prevent the appearance of sodium stannite which, in an effluent, would create high immediate oxygen demand. The example does point up the fact that the various wastes in any given electroplating shop may be used to provide an acceptable effluent without resort to large treatment plants.

Certain other materials such as hydrofluoric acid, if used in large quantities not common to the usual electroplating operations, can be disposed by lime treatment because the calcium fluoride formed is extremely insoluble; if proper arrangements are made, the material can be deposited on waste land with complete safety. This special situation is being brought up only to point out the ease with which such situations can usually be handled. In fact, the lime requirement in the instance just mentioned could be largely supplied by the waste from the acetylene manufacturing plant.

It should also be mentioned that some plating plants anodize or otherwise surface treat magnesium or aluminum and that salts of these metals are regularly used in the flocculation and purification of water supplies.

Lacquers

Before proceeding with a discussion of the chemicals from the plating baths themselves, it might be well to dispose of the lacquers, paints, etc., that are used in some plating shops. Where dry booths are used, there is no water pollution problem. However, in many instances it has been found advantageous to recover the pigment which would otherwise be thrown away as waste. The most successful method has been the use of water-wash spray booths. The water carries the pigments which have not been deposited on the surface of the object to central sump tanks where they are allowed to settle. As a rule, most high boiling oils, as well as phosphates and other substances used as plasticizers, have very low solubility in water, have a tendency to stay close to the pigment in agglomerate particles, and are removed with it by filtration for reprocessing.

Cleaning Solvents

The one waste product from cleaning which should not, under any circumstance, be delivered to the sewer systems is the sludge from halogenated-hydrocarbon degreasing operations. This has been well recognized by the electroplating industry. The sludge may be redistilled, and this in many instances is so economically mandatory that stills are sold as part of the original equipment.

However, one finally reaches a point where sludge consisting of from a few to many per cent of halogenated hydrocarbon, grease, oil, acid, and a multitude of other products must be removed. This material may be disposed of by dumping or burning in a suitable area; it may also be burned in an incinerator.

Plating Solutions

The variety of chemicals used in electroplating is quite impressive and, on the surface, would seem to make the problem of keeping waste water clean very difficult, particularly in view of the large amounts of wash water used. However, these very large quantities of water, much of it relatively free from chemicals other than those found in the normal supply, often provide a safety factor which in many instances reduces contamination to very safe levels. But this may not always be the case. For this reason, the more common types of plating baths will be mentioned with some remarks directed toward principles which have been, or can be, used in eliminating difficulties. In a few instances, at least, one waste may be balanced by another.

Among the *acid solutions* are (1) acid copper baths containing copper sulfate, sulfuric acid, and small amounts of addition agent; (2) acid zinc baths containing zinc sulfate, aluminum or ammonium chloride, and small amounts of organic agent; (3) nickel baths with various nickel salts such as the sulfate and the chloride, boric acid, and addition agents; and (4) the acid lead baths which may contain sulfamate, fluoborate, or possibly fluosilicate. In practically none of these plating solutions will be found really high acidities, and in a few instances, the materials could be dumped directly and meet current regulations without any dilution as far as *p*H is concerned.

The *chromium plating bath* holds a special position among acid baths. The high oxidizing power of chromic acid, its main constituent, may be extremely useful, particularly where discharged into open streams in reasonable quantities, because it relieves the immediate oxygen demand of other chemical wastes. Thus, the controlled delivery of chromic acid waste into other plating wastes should be a positive benefit rather than a detriment. This, of course, does not result if a bath which is no longer useful is dumped without consideration being given to scheduling of disposal with other acid and alkaline wastes.

There are special instances in which the chromic acid concentrations cannot be balanced or reduced by dilutions. Then special devices must be employed. In one instance chromic hydroxide, $Cr(OH)_3$, was formed and precipitated; in another where lead wastes were available from other manufacturing, lead chromate was precipitated, eliminating two difficulties at once. (Both lead chromate and trivalent chromium salts are nontoxic according to our studies.)

It should be noted that chromates and phosphates, which are present in plating shop waste, under specified conditions form quite insoluble salts with several of the *cations* used in plating, including lead and zinc. Most other plating cations, such as cadmium, arsenic, mercury, silver, gold, etc., are found in such small quantities that, as a rule, they need not be considered in liquid-waste disposal. Should, for any reason, dilution not be sufficient, there are in most plating shops numerous other wastes which can simply and quickly reduce their concentrations to very safe levels.

Among the *alkaline plating* baths we have already mentioned the alkaline tin solution, and propose now to consider the various *cyanide baths* which are also alkaline. Thus, copper, zinc, gold, silver and cadmium are plated from alkali metal cyanide complexes of the metal, usually in the presence of free alkali and free cyanide. Some part of the wash waters may contain some 50–100 ppm of cyanide and, of course, the cyanide plating solution itself has a cyanide content of up to 25,000 ppm.

While dilution under carefully controlled conditions can be used, in some circumstances, for the disposal of cyanide wastes, it is not recommended as there is always the possibility of the material reacting with acids liberating hydrogen cyanide and, further, even under controlled dumping conditions the concentrations may not meet with regulatory approval. Neither do we favor use of the method advocated in some quarters in Michigan which involves the collection of all cyanide wastes, their treatment with sulfuric or other acid for liberation of hydrogen cyanide, and the delivery of this gas to the atmosphere through high stacks.

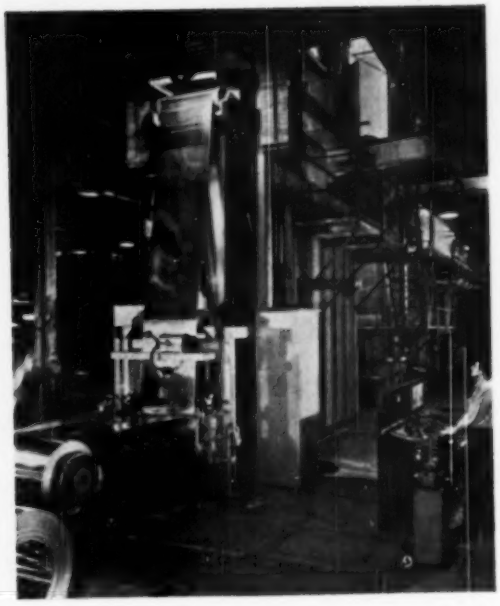
As mentioned earlier, it is our conviction that the waste inside the workroom should be collected and made innocuous if need be and not delivered to the outside air or to the outside water supply. There are a number of other ways of treating these wastes which are more satisfactory. Space does not permit a detailed discussion, but some of these ways can be indicated: (1) the cyanide waste may be delivered to lagoons if sufficient ground is available, (2) it may be treated with various sulfur compounds, or wastes containing sulfur compounds, perhaps with the addition of waste lime, and heated to form thiocyanate which may be deposited in lagoons or in porous ground areas, (3) it may be treated and oxidized to carbonate, (4) it may be oxidized with waste oxidizing chemicals and then delivered to the sewer system or, in special cases where the insoluble lead from the plant or operation is too high, be precipitated by other wastes, and (5) it may be burned. Should there be no immediately available free ground space, the same principles can be applied in settling and filtering tanks within the premises. Should oxidation be resorted to within the plant, conditions of neutrality should be observed and the operation should be conducted in a closed, ventilated place which workmen are prohibited from entering as a precaution against accident.

Conclusion

The previous discussion may make one believe that the problems are difficult. Actually, a careful analysis will show that the only problem which might, in some circumstances, involve not a particular difficulty but an expenditure of money is the disposal of cyanide wastes. It will also show that this expenditure, in most instances, will not be large because existing extra tanks and ventilation facilities can be changed and adapted to cheap oxidation of the wastes. That has been done successfully in the past, perhaps with more expensive chemicals than are needed but still at very reasonable cost. In case of doubt one should analyze the residues in the stacks where cyanides have been heat-treated. It is difficult to find any cyanide; the white powder, in all the cases examined by the writer, turned out to be largely carbonate.

The progressiveness of the plating industry as exemplified by the early installation of ventilation and other safeguards before the public was aware that airborne or water-pollution problems might exist, and its alertness in meeting any new problem, will, without doubt, make it relatively easy to meet new reasonable demands.

Entrance end of continuous tin-plating machine. In front of the seam welder are two uncoilers (not shown), one of which is in operation. When its coil has been unwound, the end of the coil from the second uncoiler is seam welded to the end of the old coil. In the meantime the machine is being fed from the 55-foot high entry looper in the background which holds about 440 feet of strip.



Discharge end of plating machine shows the quadruple exit looper which, by extending upwards as high as 48 feet, accumulates strip while a completed coil is being removed and a new coil is started on the coiling mechanism at left. Note the control panel at right from which the finished strip can be observed and all operations, strip speed, plating current, bath temperatures, etc., are controlled.

Closing the Bottle

THE LITTLE CROWN CORK is of interest to all as being what seems the ultimate solution to the once difficult problem of providing a tight bottle seal which could be applied under conditions of high production. It is of particular interest to the plater as an important outlet for electrolytic tin plate, which is one of if not the most striking engineering developments in the plating field of the last couple of decades.

This story depicts the manufacture of the crown cork as it is carried out in the main plant of Crown Cork and Seal Company in Baltimore, Md., which kindly opened its doors to PLATING, supplied information and photographs, and checked the manuscript.

Not less than 1500 U. S. patents for bottle closures had been issued when William Painter of Baltimore devised the crown cork and the first bottling machinery for its use, in 1892. Today it is the only bottle closing device, besides the old-fashioned cork stopper, used in the United States. Painter was not only an ingenious inventor (he received over 100 patents during his life time), but also an organizer and business man who formed the Crown Cork and Seal Company and laid the foundations for its phenomenal growth. Manufacturing all kinds of container closures, among them a train load of crown corks per hour, cans (including seamless cans in its Philadelphia plant), and bottling machinery, the company now has four large factories in the United States and nine in foreign countries. It did a business in 1948 that amounted to 98 million dollars.

The Baltimore plant buys hot rolled steel which it pickles and cold rolls into strip. The strip is then annealed vertically in straight-line operation, and skin rolled, before it is tinned electrolytically.

The smaller of two tin plating machines, which however employs four 10,000 ampere-8 volt motor-generators, was the first successful high-speed strip-plating machine in the world. Experimental work began in 1937 and operations in 1939. The larger machine has six motor-generators of the same capacity.

The steel usually comes to the tin plating machine with a highly reflecting surface but at times shows rainbow colors from slight oxidation. The oxides, however, are easily removed in the first bath, a 4 per cent sulfuric acid pickle containing Rodine inhibitor, during the minimum pickling time of 4 seconds (at 520 feet per minute). Following a first squeegeeing, a cold water spray, and a second squeegeeing, the strip enters the plating tank where it passesover 24 current-carrying rolls above the solution line and underneath 23 other rolls near the bottom of the tanks. At each end and between each vertical strip section are a total of 48 tin anodes and two inert iron anodes, each 78 x 28 inches and weighing approximately 2000 pounds.

When about two-thirds of the anode weight has dissolved, the machine is emptied of solution and strip, a whole new set of anodes is put into the tank, and the machine is "rethreaded" and refilled with the solution. The required green film on the tin anodes is applied by means of a short period of overloading of the motor-generator by 10–15 per cent.

The width of practically all of the strip processed in this plant is from 28 to 32 inches, or slightly more than or equal to the width of the anodes. Since in addition the tanks are only slightly wider than the widest strip, little excess tin deposits on the edges of the strip and no special arrangement is necessary to make the coating-thickness uniform.

Having been plated to specified thickness by adjustment of current, speed and bath temperature to the strip width, the strip passes between two sets of squeegee rolls, is spray rinsed twice with hot water and resqueegeed before it enters the so-called burnishing unit. In the latter the temperature is varied from 1500 to 2400° F, depending on the speed, finish and gauge of the steel. The strip then passes through a quench tank at 180–200° F. The very dilute chromic acid passivating dip finishes the cycle.

It is interesting to note that the controlled-atmosphere annealing which precedes skin rolling assures such complete removal of oil and grease that no alkaline cleaning whatever is required in the tin plating machine.

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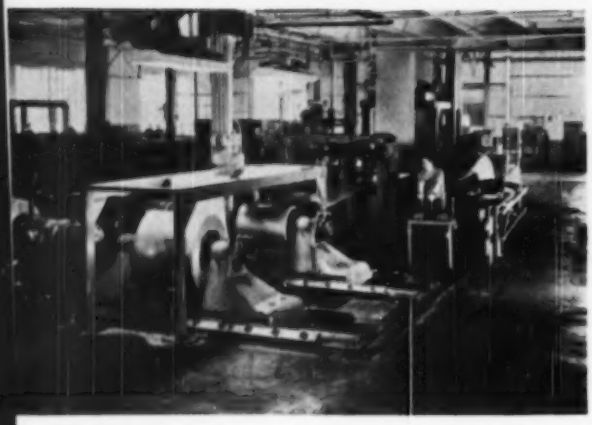
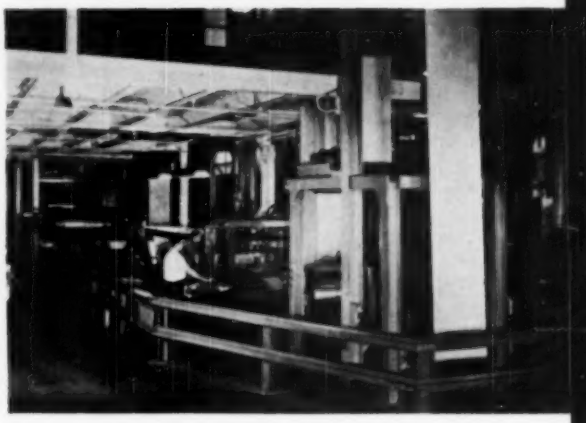
Tin plating machine, seen from catwalk, consists of a series of tanks with 9-foot deep solutions and with cold and hot water spray rinses and squeegee rolls in-between as required. The annealed and skin-rolled cold-rolled strip passes at a speed of up to 520 feet per minute in vertical loops through an inhibited sulfuric acid pickle and then through a sodium stannate solution where 0.25–0.78 pound of tin per base box is deposited. From there it goes through a 55-foot high flow unit, in which the tin is melted by gas-heated radiant-heat burners, to a quenching tank containing 200° F water and then into a passivating dip of 0.005 per cent chromic acid. Following a squeegee operation (no rinse) the strip is dried by passing through a hot air blast.



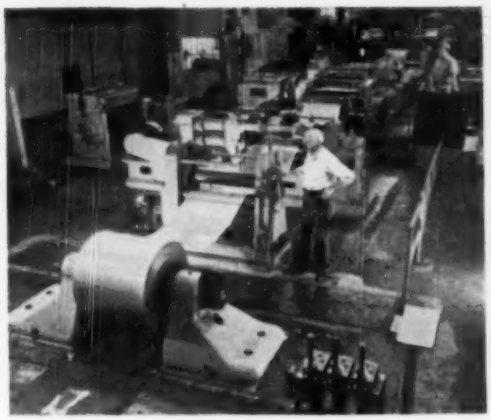
Entrance end of roller coating machine with two uncoilers and seam welder in foreground. Behind the welder is a high looper. The strip speed in this machine is 165 feet per minute.



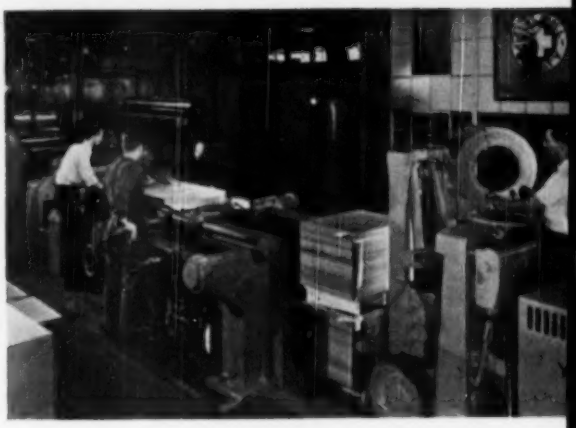
Exit end of roller coating machine in which the tinned strip is given a corrosion-protective plastic coating on one or two sides as required. In the right foreground is the coated strip on its way up to a 275-foot long gas-heated drying and cooling tunnel.

Two types of zinc plates may be used in lithographing the designs on the crown tops. In one, the albumin plate, are light acts through a camera negative on the sensitized plate-coating solution, the printing image is burned in, and the coating on the nonprinting area under the black of the negative is washed off as shown in the picture to the left. In the other, the deep-etched plate, which is used for longer runs on more intricate designs, a film positive is used to produce a protective mat over the nonprinting areas when light is applied; the water soluble image is washed off and the bare zinc etched lightly as shown on the right; after a base has been applied and the image developed, the protective mat is removed.

The zinc plate is attached to the lithographing machine in which it is alternately damped with water and inked, the water repelling the ink from the nonprinting areas while the printing areas accept the ink. The plate cylinder rotates against a rubber cylinder which picks up the ink and transfers it to the tin surface of the sheets.



Entrance end to flying-shear operation in which the tin-plated and roller-coated strip moving at 450 feet per minute is cut into sheets by means of a knife blade inserted lengthwise in a rotating roll. Tension rolls in foreground.

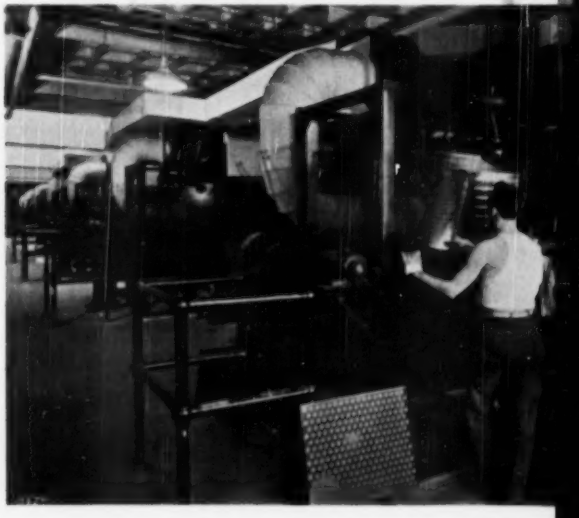


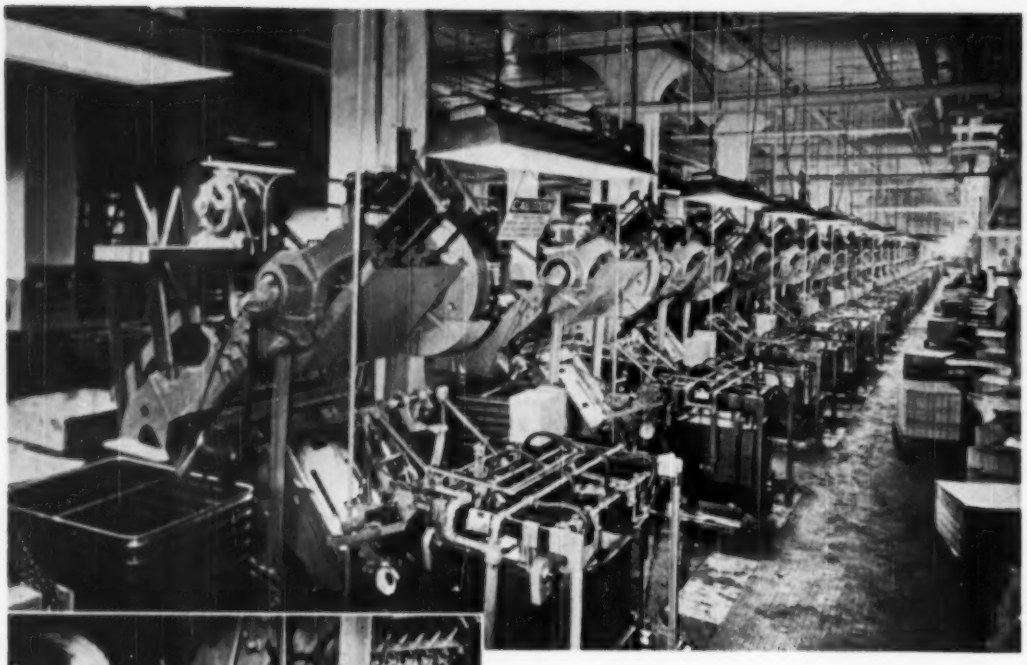
Exit end to flying-shear operation, with the flying shear to the left. An automatic gage sorts out sheets which vary ±0.005 inch from specified thickness. The sheets are then stacked 1120 to a pallet, and the pallets removed by lift truck at right.

Cover: Cutaway view of a beverage bottle with a crown cork. Note the sealing effect of the compressed cork disc and the locking action of the tinplated steel shell.

A two-color lithographic press. Chain elevator to the right lifts a pallet of sheets, from the top of which one sheet at a time is picked up by pneumatic arms which feed the press. At the upper left is the entrance to the baking oven.

Exit ends of a row of baking ovens for lithographed sheets. The sheets pass through these ovens while held in almost vertical position by means of wire racks attached to the double-chain conveyor, and are then restacked on pallets.



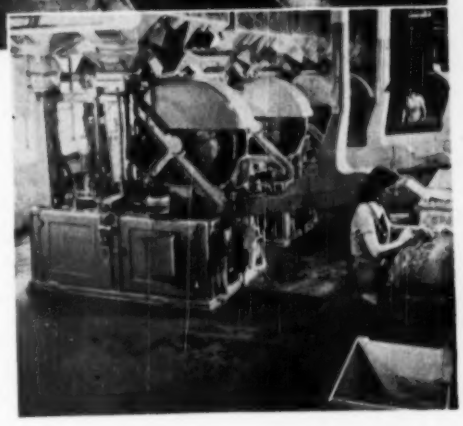


Line of punch presses, seen from feeding end, which in one operation blanket and form the crown shells from the lithographed sheet. In front of each press is a pallet from which the sheets are taken one by one by pneumatic arms and placed on the press.

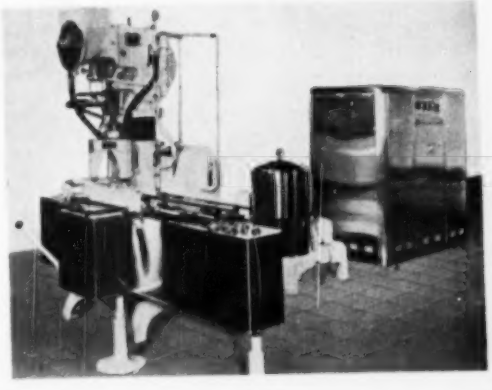
Punch press detail showing the reverse side of the lithographed sheet at bottom right, the punching dies at top right, and finished crown shells being discharged at left. The "skeleton" that is left is kicked out at the back of the machine.

Many crown corks are used to collect beverage taxes, as high as 6 cents per bottle, which are paid by the bottler to the state tax office which then gives a release to the crown-cork manufacturer for shipment of the crowns. This automatic counting machine serves to determine accurately the number of taxable crown corks in each shipping carton.

General view of crown-cork assembly room where the crown-cork disc, made of granulated cork, is cemented to the crown shell to make the finished product.



Close-up of some crown-cork assembly machines. Above each are the bins of crown shells and cork discs which are fed downward through chutes, receive adhesive, and under pressure and heat on the wheel are firmly bonded together. The crown corks are then conveyed to the inspection tables at the right.



Crown corks are used in automatic machines like this 30-bottles-per-minute Dixie F Filler-Crowner (at left), one of the smaller bottling units for soft drinks made by Crown Cork and Seal Company. The washed bottles are placed on the conveyor, filled first with syrup and then with carbonated water, crowned, and unloaded by hand. All parts that come in contact with the beverage are stainless steel or nickel silver, but some of the working parts are cadmium or hard-chromium plated, and a few are copper-nickel-chromium or nickel-chromium plated. The cabinet to the right is a cooler for the syrup and for the water, the latter being carbonated in the central saturator.

a. e. s. research project no. 6

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Porosity of Electrodeposited Metals

V. MEASUREMENT OF THE CORRODIBILITY OF METAL FOILS

In the Conclusions of Part III of this this series [PLATING 35, No. 9, 967 (1948)] it was pointed out that the gas permeability method of evaluating the porosity of electrodeposited foils will permit exact determination of the progress of corrosion particularly in its initial stages, and, above all, its quantitative expression. The inadequacy of the conventional methods of inspection of samples exposed to corrosive environments, and particularly the subjectivity of the usual terms employed in the evaluation of the degree of corrosion, need no amplification. On the assumption that corrosion would manifest itself, right from the beginning, by a progressive increase of (as yet invisible) porosity of the corroding metal foil long before the appearance of visible signs of attack (spots, pits, perforations) or a change of weight, the low pressure-constant high overpressure method of detection of gas permeability appeared indicated for comparative studies of rates of corrosion. The results obtained in that direction corroborate our basic assumption, that the porosity of a foil, as measured by its gas-permeability, increases systematically with the length of time of exposure to the corrosive environment. These results also supply empirical kinetic curves of the rate of corrosion, and reveal characteristic differences of behavior towards the same well-defined corrosive agent between foils of the same metal produced under different conditions.

EXPERIMENTAL

For our first experiments, we have selected three corrosive media, (*a*) the vapor phase above a 3-*N* hydrochloric acid solution, (*b*) a moisture-saturated, 6-mole per cent sulfur dioxide atmosphere, (*c*) a still 5 per cent sodium chloride solution. All media were maintained in closed desiccators, at room temperature. Foils, punched beforehand to the size of the samples used in our gas-permeability apparatus ($\frac{5}{8}$-inch in diameter, exposed area $\frac{3}{8}$-inch in diameter) were taken out at stated times, washed, dried, tested, and exposed again in the same medium. All tests were made by the low pressure-constant atmospheric overpressure method, described in Part IV of this series, with $\triangle p_0$ = 1 atmosphere.

This method, it will be recalled, consists in, first, evacuating both sides of the apparatus to about 0.001 mm of mercury, then opening one side to communicate freely with atmospheric pressure. If the foil is porous, the low pressure on the vacuum side will gradually rise with time at a rate dp/dt (p = pressure, t = time) obviously directly proportional to the surface area F of the foil, directly proportional to the overpressure $\triangle p$, inversely proportional to the volume V of the low-pressure side, and directly proportional to a constant k characteristic of the given foil and expressing its particular degree of permeability, that is, its porosity; the greater the porosity, the higher k.

$$dp/dt = k \times F \times \triangle p/V$$

The overpressure $\triangle p$, in this procedure, does not change in the course of the experiment, whether the high-pressure side be left open to the outer atmosphere or

be closed after admission of the atmospheric pressure, since, in the latter case, the decrease of the high pressure (say, at most a few tenths of a millimeter off an initial 760) is absolutely negligible. Consequently, in this method, Δp is constant and remains equal to the initial overpressure $\Delta p_0 = 1$ atmosphere (minus, of course, the negligible thousandth of a millimeter). Thus, all magnitudes included in the righthand member of our equation being constant, its integration is elementary, and gives for the pressure p at the low-pressure side, at any given moment t, the expression $p = k \times F \times \Delta p_0 \times t/V$, or $k = V \times p/(F \times \Delta p_0 \times t)$. If V is expressed in liters, F in sq.cm., t in minutes, the characteristic permeability constant k is expressed in liter/sq.cm.–minute.

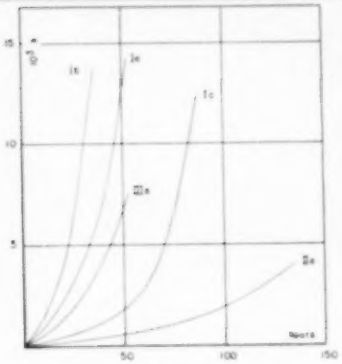

Fig. 1. Effect of corrosion on gas permeability of nickel and copper foils

The foils tested were: *I*, Electrolytic nickel foil produced from a sulfate bath at 60° C (140° F), thickness 25 microns (0.001 inch); *II*, Electrolytic nickel foil produced from a chloride bath at 60° C, thickness 25 microns; *III*, Electrolytic copper foil produced from a sulfate bath, thickness 12 microns (0.0005 inch); *IV*, Wrought nickel foil of 25-micron thickness, kindly put at our disposal by A. Mendizza of the Bell Telephone Laboratories. All these foils were impermeable at the outset.

TABLE I. CHANGE IN PERMEABILITY CONSTANT k OF NICKEL AND COPPER DEPOSITS ON EXPOSURE TO CORROSIVE MEDIA

Designation	Type Bath	Corrosive Medium	Hours of exposure	k l/sq.cm.-min.
Ia	Nickel Sulfate	Vapor above 3.0-N HCl	0	0
			5	6.0×10^{-3}
			9	2.4×10^{-3}
			20	7.5×10^{-3}
			35	1.8×10^{-2}
			50	4.5×10^{-2}
			120	3.2
Ib	Nickel Sulfate	H_2O-saturated 6-mole % SO_2	0	0
			4.5	3.8×10^{-7}
			16.0	2.8×10^{-6}
			31.0	1.0×10^{-5}
			47.5	2.0×10^{-5}
Ic	Nickel Sulfate	5% NaCl Solution	0	0
			8.5	3.8×10^{-7}
			48.0	9.6×10^{-7}
			54.0	2.9×10^{-6}
			68.5	6.1×10^{-6}
			89.5	1.2×10^{-5}
IIa	Nickel Chloride	Vapor above 3.0-N HCl	0	0
			15	9.6×10^{-8}
			20	2.9×10^{-7}
			52	4.6×10^{-7}
			70	9.6×10^{-7}
			125	3.2×10^{-6}
IIIa	Copper Sulfate	Vapor above 3.0-N HCl	0	0
			5	1.9×10^{-7}
			12	5.5×10^{-7}
			20	1.9×10^{-6}
			50	6.7×10^{-6}

Results

Of these foils, *IV* showed no trace of permeability after 120 hours in either *a*, *b* or *c*, and is, consequently, not included in the figure. The copper foil, *III* corroded fast in *a*. *II* showed permeability only on exposure to *a*, none in *b* or *c*, whereas *I* showed distinct corrosion in all three media, within the stated time of exposure.

The progress of the increase of permeability in cases *Ia*, *Ib*, *Ic*, *IIa* and *IIIa*, is illustrated in Table I and in the plot of k (in liter/sq.cm.–minute) as a function of the time of exposure, in hours, which is found in Fig. 1.

None of the foils exposed showed, as yet, any visible perforations. Exposures will be continued until appearance of gross defects renders further permeability tests pointless.

Discussion

These preliminary results show a number of striking features.

At equal thickness, in the same corrosive medium *a*, electrolytic nickel from a warm chloride bath (*II*) is corroded incomparably slower than electrolytic nickel from a warm sulfate bath (*I*). The former was not attacked at all (so far) in *b* even though, in this medium, the sulfate-nickel foil corroded faster than in *a*, nor was it attacked in *c*. At the same thickness, wrought nickel (*IV*) was, so far, uncorroded in either of the three media. Without as yet attempting to formulate any doctrine, let us recall that, as reported in Part IV, we found wrought nickel, even as thin as 2.5 microns (0.0001 inch), impermeable and could not but conclude that wrought nickel is, at least, by many orders less porous than electrolytic nickel. The observed extreme slowness of corrosion of wrought nickel as compared with electrolytic nickel *may* be determined by the original very great difference of porosities. Further discussion of this point, the decisive significance of which for our understanding of the relations between porosity and corrosion needs no stressing, must be postponed until further experimental material has accumulated.

The curves show clearly the self-accelerating nature of the "hidden" corrosion process. However, the progress of that corrosion cannot easily be described by any single kinetic equation. While the curves *Ia*, *Ib* and *IIIa* might be expressed by an exponential function of the time of exposure, curve *Ic* clearly shows two stages: an initial stage of relatively slow and slowly accelerating corrosion, turning into a fast, exponential-like rate. Possibly, the portion of *IIa* so far ex-

(Continued on page 959)

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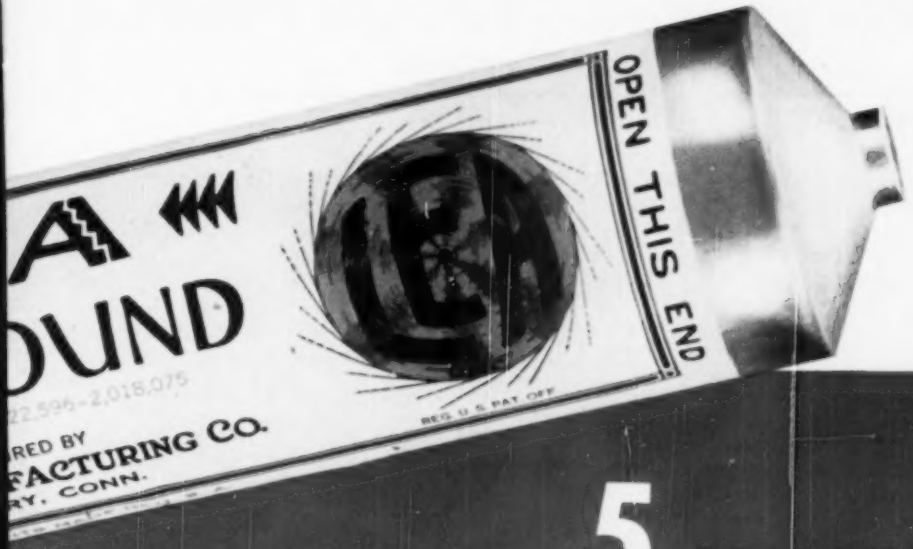

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——readers' questions of general interest——

Q. 55. What special treatment do you advise be used prior to silver plating of pewter metals (tin-lead alloys)?

A. The following cycle is recommended: (1) Buff to a good lustre leaving a minimum of buffing-compound residues; (2) precleau to shorten time in alkaline cleaner by means of trichlorethylene vapor or vapor-solvent degreasing, or treatment in emulsion cleaner; (3) clean cathodically or by soaking in a solution containing some metasilicate to reduce attack on the metal, trisodium phosphate, sodium carbonate, and a wetting agent that is not precipitated as insoluble lead or tin salt. Current densities should not exceed 25 asf, and bath temperature should not exceed 180° F or undue attack will result; (4) rinse with running water; (5) dip in 5 per cent by weight fluoboric acid at room temperature for about 10 seconds. If fluoboric acid is unavailable, use hydrochloric in preference to sulfuric acid; (6) rinse thoroughly; (7) dip in a solution of 2 oz/gal of each sodium cyanide and sodium hydroxide to dissolve any remaining oxides and neutralize any remaining acid film; (8) copper plate in cyanide copper solution; (9) rinse in running water; (10) silver strike and silver plate in the usual manner.

It is this writer's opinion that highest adhesion is obtained with copper plate. However, many prefer nickel plate because of its hardness and white color (if the silver is abraded through). It may be applied either in place of steps 6–8 or in after copper plating. The latter minimizes extent of nickel cracking if bright nickel is used, as is common. The more ductile the bright nickel, the better.—W. R. Meyer.

Q. 56. I am having trouble with blistering when I plate nickel silver. Use of copper in the first silver strike helps somewhat. What procedure should I follow?

A. Nickel silver easily becomes passive and, to take an adherent coating, should be activated by *one* of the following treatments applied after cleaning: (1) immerse in 50 per cent muriatic acid; (2) treat anodically in 32° Be sulfuric acid free from chloride at 6 volts for 10–15 seconds; (3) bright dip in a solution of 1 part sulfuric, 1 part nitric acid, 1 part water, containing 0.2 oz/gal muriatic acid; (4) strike for 10–15 seconds at 6 volts in Wood's solution: 32 oz/gal nickel chloride, 16 fl.oz/gal hydrochloric acid; (5) strike in regular or Rochelle salt type cyanide-copper solution at 140° F, containing sodium thiosulfate if bright deposit is required.

Of these, treatment (1) is preferred for holloware, (4) for flatware. A mercury dip has been used but is not recommended. The copper-containing silver strike does not always help, especially on highly buffed surfaces.—G. B. Hogaboom.

Q. 57. What are suitable bath formulas for plating heavy deposits (0.0017 inch) of red 14K and 18K gold?

A. Copper is added to gold solutions to produce red or pink gold shades. The exact amount required for 14K and 18K colors is difficult to specify, and it is probable that both may be had in the same bath by variations of the temperature, degree of agitation and current density. The following formula is suggested:

Metallic gold (as cyanide)	3.1 g/l
Copper cyanide	0.8–1.0 g/l
Disodium phosphate	6–8 g/l
Sodium or potassium cyanide	sufficient to dissolve gold and copper salts plus slight excess
Temperature	45–55° C (113–131° F)
Current density	1–5 asf
Anodes	stainless steel, platinum or carbon

The gold content may be varied over a considerable range. The higher the ratio of gold to copper, the yellower the deposit; the lower the ratio, the redder. The disodium phosphate aids in maintaining the color, favoring the lower carat shades. It also permits a high percentage of the gold to be plated out at constant color as long as current density and temperature are maintained at their desired values. Low free cyanide gives high efficiency, high concentration leads to yellower deposits. Low current density and high temperature favor the more yellow colors. Gold and copper salts should be added as the bath becomes depleted.—F. K. Savage.

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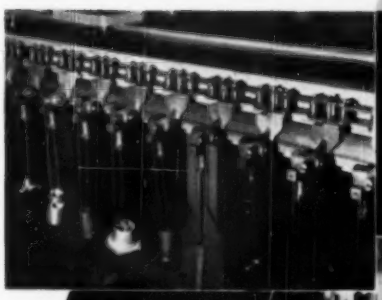

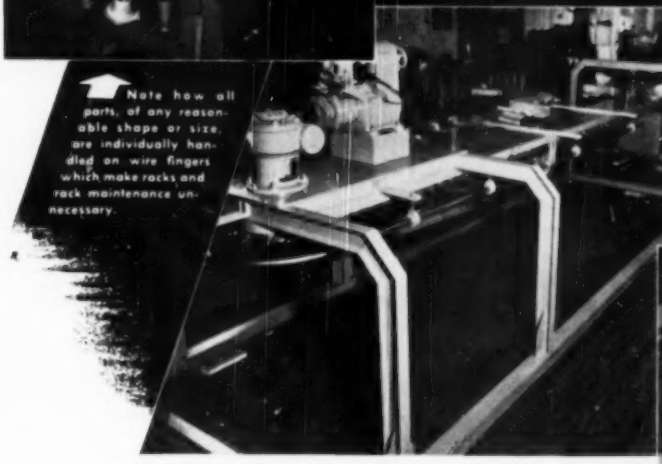

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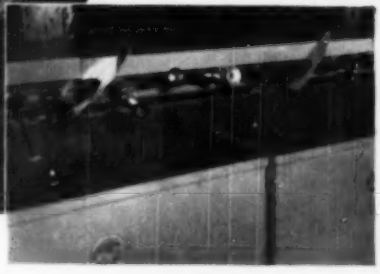

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Book Review — DR. HAROLD J. READ, *Associate Professor of Metallurgy, Pennsylvania State College*

JOURNAL OF THE ELECTRODEPOSITORS' TECHNICAL SOCIETY, Vol. 22, 1946–1947, 272 pages. Electrodepositors' Technical Society, 27 Islington High Street, London, N. 1, England. Price, non-members, two guineas.

As usual, this book is a collection of papers presented before the E. T. S. during the stated year. There is no central theme, and the papers cover a wide variety of subjects. Of the nineteen papers, seven pertain to testing or analysis of deposits or solutions, four deal with various aspects of nickel plating, two are concerned with electropolishing, and the remainder cover a variety of subjects such as cost estimation, metallizing of glass and plastics, finishing of zinc alloy die castings, and treatment of plating and pickling wastes. Most of these papers are of more than passing interest, but it will be possible in the space at our disposal to discuss only a few of those which seemed most outstanding to the reviewer.

Smoothing action as a mechanism in bright nickel plating is the subject of a very interesting contribution by G. E. Gardam. He studied the smoothing action by microscopical examination of the cross-section of plated cathodes which had been previously serrated according to an arbitrary but uniform pattern and by optional reflectivity tests on deposits prepared on either polished or matte cathodes. A considerable variety of nickel solutions as well as a few solutions for other metals were investigated, and the results are concisely reported in tables, graphs, and photomicrographs. The evaluations by either method are qualitative with little hope that they can be made quantitative. The results are, however, of great value in the rating of one solution with respect to another.

Numerous papers are easily found in the literature on the behavior and operation of brass plating solutions, but material on the effect of the basis metal on the electrodeposition of brass is extremely scarce. A paper by W. D. Rae indicates that there is much to be learned along these lines. His primary concern was with nonuniformities of the deposit which give rise to inferior rubber-to-brass bonds. One feels sure that at least some of the experimental methods and many of the conclusions set forth in this paper will be challenged, and it is annoying to see the word "strain" used where "stress" was obviously meant. In spite of the deficiencies of the paper, it should have a very real value in stimulating further research along these lines.

P. B. Upton has prepared a fine paper on the metallizing of glass and plastic articles by the reduction of aqueous solutions. He has extracted the meat of 126 references, and formulated therefrom a most readable resumé. Most articles on metallizing have tended to be a mere collection of recipes, but Upton has brought order out of the chaos. Much of the information has been tabulated so that one can see at a glance material which would normally occupy many paragraphs of descriptive text. Table I, for instance, presents on less than a page the probable or claimed advantages and the actual uses of all the methods of producing chemical silver films—and gives literature references into the bargain.

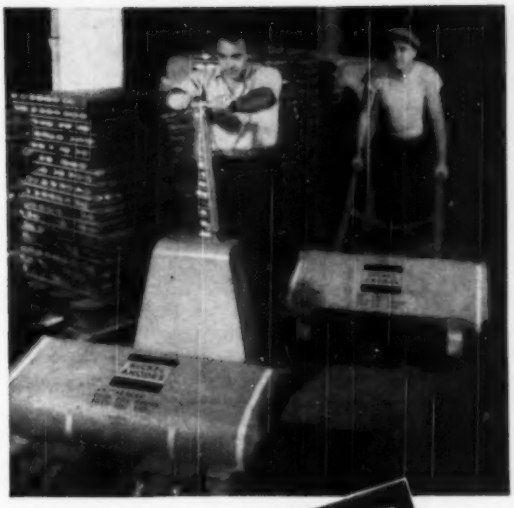
Accounting in the plating shop has been discussed to a considerable extent in the recent literature, but A. W. Wallbank's extensive article on this subject will doubtlessly prove valuable to those who are concerned with the financial side of plating operations. He makes extensive use of figures (graphic, not monetary) in expounding his ideas, and even to one who is unacquainted with the subject, his thoughts and suggestions were easily understandable.

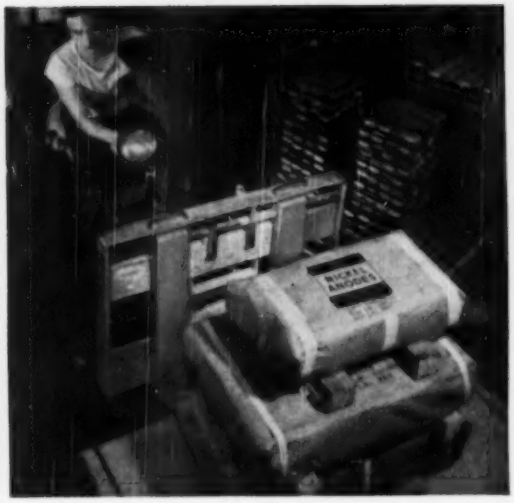
E. W. Mulcahy's paper on the treatment of plating and pickling shop wastes does not present any new ideas for the treatment of these materials, but he does discuss very thoroughly the methods by which existing treatments may be efficiently and economically applied. There are descriptions and illustrations of suitable equipment. The brief section on costs will probably have little application to American plants.

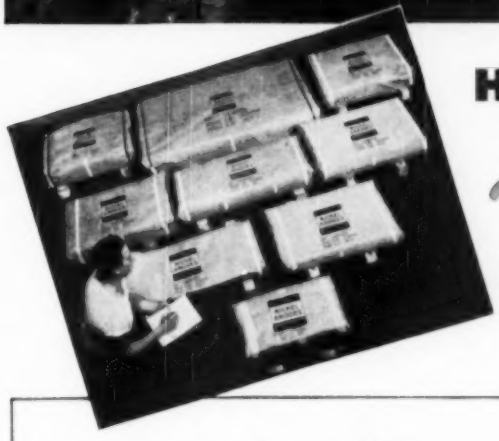
The analysis of solutions used for the deposition of hard chromium is discussed by H. E. Styles who employs a specially constructed photoelectric absorptiometer in his determinations. It is claimed that simple, rapid estimations can be made of the sulfate, chromic acid, iron, and trivalent chromium contents of the plating solutions. The apparatus is not particularly complicated, and it should be relatively easy to construct from components available in America. The discussion of the analytical techniques and the effects of the factors which may influence the results is very complete. In another paper on the analysis of chromium plating solutions, F. W. Salt describes how the usual chemical methods of determination were altered to make possible the complete analysis of the solution in one and one-half hours where it had previously taken four hours. The suggested modifications appear to be sound.

A paper on the factors affecting the distribution of electrodeposits by N. A. Tope is an essentially practical and somewhat empirical approach to a vexatious problem which has long plagued electroplaters. There is not much here which will be of immediate value to the man in the shop, but some thoughts and observations should help to stimulate further work.

Most of the discussion is collected at the back of the book, but in at least one case, it follows the papers concerned. It would seem desirable to hold consistently to one system or the other.







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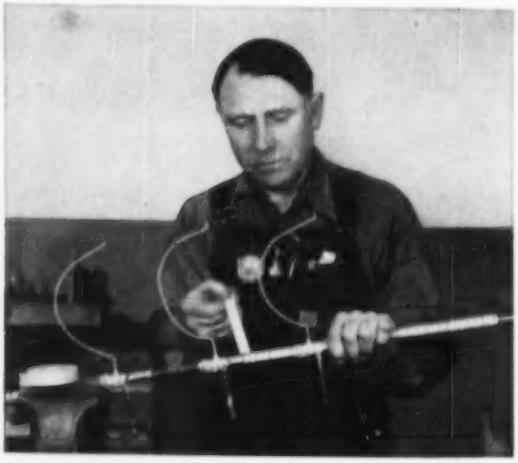

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Article Abstracts

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Increase of Tool Life by Electropolishing Plus Chromium Plating. G. Ye. Pochtar' and A. M. Gur'ev. Stanki i Instrument **18**, no. 3, 27 (1947); Henry Brutcher, Altadena, Calif. Translation No. 1993.

Recommends chromium plating preceded by electropolishing, for high-speed tools containing 4–9.5 per cent tungsten, to produce an increase in tool life of 50–150 per cent. Gives data on best electropolishing and plating conditions.

Properties and Condition of Electrolytically Produced Metals Having High Contents of Nonmetallic Impurities. Ernst Raub. Z. Metallkunde **39**, 33–44 (February, 1948).

The effect of nonmetallic inclusions on the properties of electrolytically produced silver and copper and effects of heat-treating were determined. Data are graphed and tabulated. Includes X-ray diffraction patterns and photomicrographs. 14 ref.

Behavior of Hydrogen in Steel During and After Immersion in Acid. Lawrence S. Darken and Rodney P. Smith. Corrosion **5**, 1–16 (January, 1949).

Experiments described are of two principal types, one designed to measure the permeability of steel to hydrogen, the other to measure the saturation concentration and diffusivity of hydrogen in steel, in each case with particular reference to factors associated with the solution in which the steel was immersed. Data are tabulated, graphed, and discussed. Appendix consists of a derivation of an equation for diffusion of hydrogen from a plane surface into steel.

The Corrosion of Metals in Atmospheres Containing Sulfur Dioxide. Part I. G. Tolley. J. Soc. Chem. Ind. **67**, 404–407 (November, 1948).

Results are presented for the corrosion of mild steel, sprayed aluminum and aluminized steel by air containing from 0.2–6 per cent sulfur dioxide at temperatures of 300–700° C. The influence of gas velocity, temperature, and concentration of sulfur dioxide was determined. Corrosion-time curves up to 40 hours are given for 0.2 and 4 per cent sulfur dioxide air mixtures at 600° C. Small concentrations of water vapor in the gas decrease corrosion of mild steel, but further additions increase it. The results show that the catalytic formation of sulfur trioxide on the surface of the metals is of great importance in determining the rate of corrosion.

Influence of Tellurium on Hydrogen Adsorption of Steel During Its Cathodic Polarization

in Solutions of Sulfuric Acid. M. N. Polukarov. Zhurnal Prikladnoi Khimii **21,** 611–619 (June, 1948). Experimental data on the influence of tellurium on the rate of hydrogen absorption are tabulated and discussed. 12 ref.

The Oxygen Efficiency in Anodic Oxidation of Aluminum. John Kronsbein. J. Electrochem. Soc. **94,** 353–366 (December, 1948).
Describes experiments that lead to the abandonment of the view that anodic coatings on aluminum "grow inward" because of slow chemical solubility of the oxide. Introduces the idea of "oxygen efficiency"—the fraction of the electric current responsible for formation of aluminum oxide, the remainder causing either generation of free oxygen or anodic dissolution of the metal. This leads to simple equations permitting correlation of current density, temperature of electrolyte, and concentration with efficiency. Graphs indicate close parallelism with an abrasion test used for evaluating quality of anodic coating. Adjustment of the theory to take into consideration chemical solubility of oxide leads to expressions showing that the oxide coating grows to a maximum thickness, in agreement with results obtained by Mason and Slunder. An expression for oxide loss by chemical solution is also derived and verified experimentally.

Gold and Chromium Combination Plating. W. A. Hopkins. Iron Age **162,** 60–61 (December 23, 1948).
The area of the base nickel plate to be gold plated is masked during chromium deposition. Then the entire part, unmasked, can be gold plated since the gold will adhere to the nickel surface but not to the sections already covered with chromium.

Barrel Plating; Plant—Processes—Electrolytes. R. Macnair. Metal Industry **73,** 366–368 (November 5, 1948); 406–408 (November 19, 1948); 448–451 (December 3, 1948).
Describes the various types of plant, solution capacities, and current allowances, and discusses the latest developments in horizontal and automatic plating barrels

Hard Chromium Plating of Light Alloys. Jos. Patrie. Rev. de l'Aluminum **25,** 335–338 (November, 1948).
Experimental data obtained permitted establishing optimum conditions for the electrodeposition of a rather thick coating of chromium (0.0008–0.04 inch) and the necessary composition of the electrolyte. Illustrated by photomicrographs.

The Present Status of Tungsten Plating. A. Pollack. Schlief-Polier-und Oberflachentechnik **21,** No. 6 (1944); Henry Brutcher, Altadena, Calif., Technical Translation No. 1990.
Critical review of the international literature and of patents on the electrodeposition of tungsten, with

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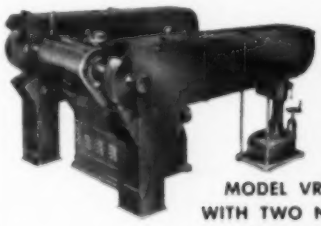

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shortcomings of the solutions known at the present time.

Rapid Determination of Copper in Nickel Plating Baths. V. V. Drozdov *et al.* Zavodskaya Laboratoriya **13**, No. 10 (1947); Henry Brutcher, Altadena, Calif., Technical Translation No. 2115.
Discusses difficulties encountered in direct determination of copper in nickel plating baths by hyposulfite titration, and presents a study of effectiveness of addition of fluorides to insure complete fixation of ferric iron.

Applications of the Plastic Replica Process to Surface Finish Measurement. C. Timms and C. A. Scoles. Plastics (London) **13**, 24–28, 44 (January, 1949).
The authors describe the use of plastic impressions for measuring the degree of surface finish of large engineering components, such as marine gear teeth and the flanks of master lead-screws, which are not readily accessible to the exploring probe of standard-design surface-finish recording instruments. Fundamentally, the process consists in taking a plastic replica of a machined surface on a strip or film of cellulose acetate and measuring the impression thus obtained by means of a stylus-recording instrument. The accuracy of reproduction is quite good, but there is a slight reduction in depth due to shrinkage of the plastic film which in general amounts to about 10 per cent of the total depth for machined surfaces.

Electrolytes for Refining and Electrodeposition of Lead. I. Influence of Surface-Active Substances on the Kinetics of the Cathode Process and Structure of the Deposit. M. Loshkarev and I. Mark. Zhurnal Prikladnoi Khimii **21**, 589–599 (June, 1948).
Effects of a series of organic additives and anions on the kinetics and structure of the above were investigated. Surface activities of these substances were found to be the basic regulators of deposit growth. Photographs, tables, and diagrams illustrate the article. 16 ref.

Spectrophotometric Determination of Iron and Titanium in Cathode Nickel. G. Victor Potter and Clarence E. Armstrong. Anal. Chem. **20**, 1208–1209 (December, 1948).
Describes a rapid and reproducible method which depends upon formation of iron and titanium complexes of disodium 1, 2-dihydroxybenzene-3, 5-disulfonate.

Measurement of Chromium Plating Thickness. C. H. R. Gentry and D. Newson. Electroplating and Metal Finishing **1**, 759–765 (December, 1948).
Describes semi-automatic apparatus for routine checking to specification limits by unskilled operators; and another one suitable for laboratory testing.

Patent Abstracts

By GEORGE B. HOGABOOM
Consultant, New Britain, Conn.

Copies of patents may be obtained by writing to Commissioner of Patents, Washington 25, D.C. Price 25 cents each.

No. 2,462,870, March 1, 1949—Electrodeposition of Copper—Frank R. Keller, assignor to General Motors Corporation

In accordance with the present invention bright or semi-bright copper deposits are secured by the combined and coordinated effect of two addition agents, each of which has been previously suggested and used but so far as I am aware have not before been employed in conjunction, for example, molasses and thiourea.

I have discovered that molasses in small quantities exerts a remarkable effect upon the action of thiourea. In the first place, it increases the tolerance of the bath for thiourea so that larger amounts of thiourea can be used with corresponding increase of the brightening effect.

The following is given as an example of a typical installation:

Copper sulfate	210 g/l
Sulfuric acid	30 g/l
Molasses	0.80 g/l
Thiourea	0.04 g/l
Temperature	70° F
Current density	70–75 asf

CLAIM 4. A bath for electrodeposition of copper in a bright or semi-bright condition comprising an aqueous solution of copper sulfate, 50 to 250 grams per liter, and sulfuric acid, 5 to 100 grams per liter, and containing as essential ingredients for production of brightness, molasses, 0.1 to 2 grams per liter, and thiourea, 0.002 to 5 grams per liter.

4 claims.

References cited: U. S. Patents 1,464,149; 1,465,034; 1,544,726; 1,805,920; 1,903,860. Holdeman, 1936 Thesis at Purdue University, pp. 14, 23, 24 and 36. Metal Industry, p. 433 (November 29, 1940). Metal Finishing, p. 457 (September, 1942).

No. 2,463,190, March 1, 1949—Method of Producing Nickel Powder from Printing Press Plates and the Like—A. E. Lundbye, assignor to Crowell-Collier Publishing Company.

An object of the present invention is to provide a method of recovering substantially pure metallic nickel in powdered form from a plate or other article having layers of nickel and copper thereon.

Still another object of the invention is to provide a method wherein the nickel may be stripped from the plates or other nickel and copper plated articles in a relatively short length of time, purified and deposited

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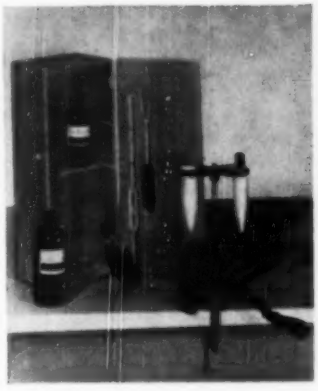

This apparatus enables anyone to accurately and quickly determine the sulfate content of a chromium plating solution.

For consistently good plating results, the ratio of sulfates to chromic acid must be maintained within very definite limits so that a constant check must be kept.

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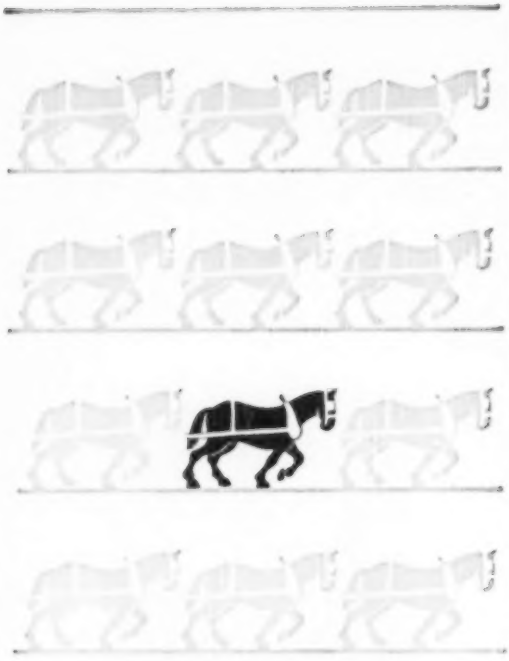

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as a finely divided powder which is suitable for production of nickel electrodes of sufficient purity to be used in plating operations.

CLAIM 3. A method of forming nickel powder from printing plates which plates are made of a layer of nickel and an underlying layer of copper and a supporting base formed of an alloy of lead, tin and antimony underlying said copper layer, which consists of thoroughly washing the plates, placing the plates in an acid electrolytic bath consisting of about a 10 per cent solution of hydrochloric acid containing about 3 ounces of boric acid per gallon of solution, keeping the bath at about room temperature, passing a current of sufficient density through the bath to strip the nickel from the plate as an anode, passing hydrogen sulfide through the acid electrolytic bath to precipitate the copper and other ions, heating the acid electrolytic bath to approximately 150° F, filtering the same, and electrodepositing the nickel as a powder from said filtrate on a cathode at a current density between 3 and 5 amperes per square inch.

5 claims, 5 figures.

References cited: U. S. Patents 1,067,698; 2,155,392; 2,199,391; 2,333,103. British Patent 312,441. Australian Patent 110,028. "Handbook of Chemistry and Physics", 16th ed., 1931, Chemical Rubber Company, p. 524. Metal Cleaning and Finishing, pp. 379, 380 (May, 1937). J. Electrodepositors' Tech. Soc. p. 40 (1934).

No. 2,466,095, April 5, 1949—Electrochemical Process for Polishing Tantalum—F. J. Gall and H. C. Miller, assignors to The Pennsylvania Salt Manufacturing Company.

CLAIM 1. The electropolishing of metallic tantalum by making it anodic in an electrolyte containing 2 to 7 per cent by weight of hydrogen fluoride and 75 to 98 percent by weight of sulfuric acid, the combined acid concentration being between 77 and 100 per cent, the balance being substantially water, and passing current at an anodic density of from 40 to 160 milliamperes per square centimeter (37–149 asf) until the metal surface has developed a high, mirror-like polish.

CLAIM 2. The electropolishing of metallic tantalum by making it anodic at a current density of 40 milliamperes per square centimeter (37 asf) in an aqueous solution of hydrofluoric and sulfuric acids containing 4 per cent by weight of hydrogen fluoride and 89 per cent by weight of sulfuric acid, the balance being substantially water, until the metal surface has developed a high, mirror-like polish.

2 claims.

References cited: U. S. Patents 2,115,005; 2,153,060. British Patents 21,950; 530,041. Trans. Electrochem. Soc. 78, 265–272 (1940). "Comprehensive Treatise on Inorganic Chemistry", by Mellor, vol. 9 (1929), p. 891.

No. 2,466,677, April 12, 1949—Electrodeposition of Nickel from an Acid Bath—Henry Brown, assignor to The Udylite Corporation.

It is a remarkable fact, for example, that in a warm nickel chloride bath (300 g/l $NiCl_2$ and 35 g/l H_3BO_3) which gives very brittle darkish plate (evidently due to basic salt inclusions) at *p*H values of 4–5, the addition of about 4 g/l of vinyl sulfonamide or allyl sulfonamide (added as the Ni salt) will produce very ductile ,fine-grained plate of good luster, brightness, and color, under otherwise the same conditions, i. e., temperatures, *p*H values, and current densities, whereas 1.5 naphthalene disulfonic acid or m-benzine disulfonic acid will not accomplish this and the plate is still very brittle and of poor darkish color, even though finer-grained than that from the plain nickel chloride bath. These facts also hold true in other high-speed plating baths containing high nickel chloride concentrations, for example, 150 g/l of nickel sulfate and 150 g/l of nickel chloride. It is also interesting to note that formaldehyde at about 1 g/l also gives brittle, darkish, fine-grained frosty plate in the high nickel chloried baths.

CLAIM 4. A method for electrodepositing fine-grained, lustrous nickel comprising the step of electrodepositing fine-grained, lustrous nickel from an aqueous acid plating solution having dissolved therein and constituting the essential electrolyte thereof a material selected from the group consisting of nickel chloride, nickel sulfate, a mixture of nickel sulfate and nickel chloride, nickel sulfamate, a mixture of nickel sulfamate and nickel chloride, nickel fluoborate and nickel sulfate, a mixture of nickel sulfate, nickel chloride and nickel fluoborate, and a mixture of nickel fluoborate and nickel sulfamate, said solution also having dissolved therein an unsaturated organic compound selected from the group consisting of vinyl (ethylene) sulfonamide and allyl sulfonamide in a concentration sufficient to increase the luster and brightness of the nickel deposit and falling within a range of from 0.05 gram per liter to saturation.

4 claims.

References cited: U. S. Patents 2,171,842; 2,191,813.

No. 2,468,825, May 3, 1948—Plating—George W. Jernstedt, assignor to Westinghouse Electric Corporation

According to the present invention, metallic base members, when coated with a thin electrodeposited layer of a ternary alloy composed essentially of from 50–75 per cent copper, 20–35 per cent tin and 8–15 per cent zinc by weight having a brilliant silvery appearance without buffing or polishing, are suitable for the direct application of an electrodeposited layer of chromium thereon. The chromium applied in this combination is of brilliant appearance. The composite coating is unequalled by any other known plating of equal thickness with regard to its corrosion resistance, brilliancy of color, and resistance to abrasion and wear. The ternary alloy plate balances any unsatisfactory features of chromium plate and cooperates to enhance the best properties of chromium.

To secure an electroplating bath of the above composition, the following chemicals in the indicated quan-

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40 Volts
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2—1000 Ampere, Chandeysson Synchronous, 25 degree 450 RPM

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3—1500 Ampere, 20 V. Elec. Prods.
1—1000 Ampere, 25/35 V. Diehl
1—175 Ampere, 25 V. Cr. Wh.
1—500 Ampere, 32 V. Columbia
2—100 Ampere, 30 V. Gen. Elec.
2—200 Ampere, 32 V. Gen. Elec.
2—1500 Ampere, 32/40 V. E. P.
1—1000 Ampere, 33 V. Gen. Elec.
2—200 Ampere, 42 V. Gen. Elec.
3—1500 Ampere, 45 V. Century
1—1500 Ampere, 50 V. Gen. Elec.
2—800 Ampere, 50 V. Gen. Elec.
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1—1000 Ampere, 60 V. Gen. Elec.

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ities, may be added per 1000 parts of water.

	Parts
Copper cyanide	2–40
Sodium cyanide	4–40
Zinc cyanide	3–8
Sodium stannate	1.5–2½
Sodium carbonate	15–70

CLAIM 2. An article of manufacture comprising, in combination, a ferrous base member, a thin electrodeposited coating of a thickness of from 0.1 to 0.5 mil of a bright silvery ternary alloy composed of 50–75 per cent copper, 20–35 per cent tin and 8–15 per cent zinc applied to the base member, and a thin coating less than 0.1 mil in thickness of chromium electrodeposited over the ternary alloy.

CLAIM 3. ... an electrodeposited coating of copper applied to the ferrous base member ...

CLAIM 4. ... an electrodeposited coating of brass ... applied to a ferrous base member ...

4 claims.

References cited: U. S. Patents 1,615,585; 1,651,278; 2,181,773; 2,198,365. "Metals Handbook", 1939 ed., pp. 1481–1482. "Eng. Alloys", p. 258.

No. 2,470,775, May 24, 1949—Electroplating Nickel and Cobalt with Periodic Reverse Current—G. W. Jernstedt and Myron Ceresa, assignors to Westinghouse Electric Corporation.

This invention relates to the electrodeposition of nickel, cobalt, and their alloys with each other by means of periodically reversed current.

In ... Patent 2,451,341 (to G. W. Jernstedt) granted October 12, 1948 there is disclosed a periodic reverse current cycle having a cathodic period of from 2 to 40 seconds and an anodic period of from ½ to 10 seconds, which has been found useful for plating a great variety of metals, including copper, brass, gold and the like. Some benefits have been secured in plating nickel and cobalt and their alloys with the cycle disclosed in that application. However, we have discovered in accordance with the present invention that a periodic current in which the cathode portion of the cycle applied to the member being plated with nickel is two seconds or less and preferably less than ½ second will produce unexpectedly improved, highly polished, smooth nickel, cobalt and nickel-cobalt alloy electrodeposits. In most cases the electrodeposits will be mirror-like. The anodic portion of the cycle should be from ½ to 1.25 of the cathodic portion of the cycle and the current densities adjusted so that the anodic portion of the cycle applies from 4 to 60 per cent of the coulombs of current applied during the cathodic portion of the cycle.

CLASS 3. In the process of electroplating bright deposits of a metal selected from the group consisting of nickel, cobalt and nickel-cobalt alloys on a member from an aqueous electroplating electrolyte containing

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the metal and having a *p*H of not more than 6, the steps comprising contacting the member with the electrolyte and applying to the member an electrical current, the electrical current being periodically reversed to render the member cathodic for a period of time of no longer than one-half second to electrodeposit an increment of metal thereon, and then to render the current anodic between successive cathodic periods for a period of time equal to about one-fifth of the cathode time period to deplate the metal, the anodic period being not less than 1/500 of a second, the current density on the member being substantially the same during the anodic and the cathodic periods.

7 claims, 2 figures.

References cited: U. S. Patents 1,260,661; 1,534,709; 1,574,055. Swiss Patent 161,317.

No. 2,470,741, May 17, 1949—Automatic Agitator for Apparatus Subjecting Liquid to Electrical Potential between Electrodes—H. L. Gordon, assignor to Premier Crystal Laboratories.

There are many industrial processes wherein solutions or emulsions are electrically treated . . . Thus, in electroplating or in electrolysis, a film of gas bubbles tend to collect on one or more of the electrodes which act as an insulator and increase the resistance of the solution or emulsion, tending to cut down the current flow.

CLAIM 6. An automatic agitator for an apparatus wherein an electrolyte is subjected to an electrical potential between electrodes comprising a container for the electrolyte, said container having a vibratory wall portion, electrical means for driving said vibratory wall portion, and a control circuit connected to said electrical means and in series with the electrodes, said control circuit including means for energizing said electrical means in accordance with the resistance across the electrodes.

6 claims, 3 figures.

References cited: U. S. Patents 1,428,049; 1,942,046; 1,942,480; 1,965,399; 2,046,467; 2,257,997. British Patent 557,386. Alien Property Custodian Publication No. 335,549, dated May 18, 1943.

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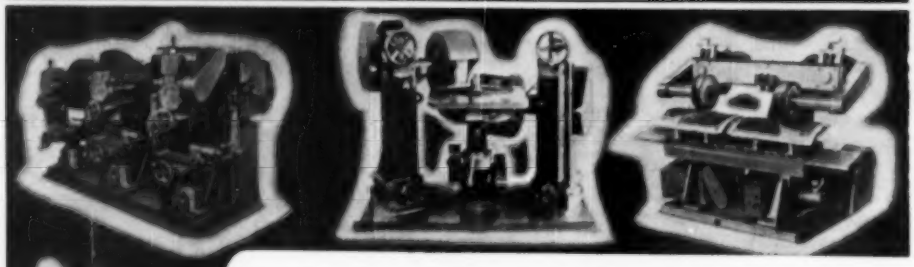

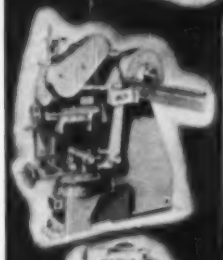

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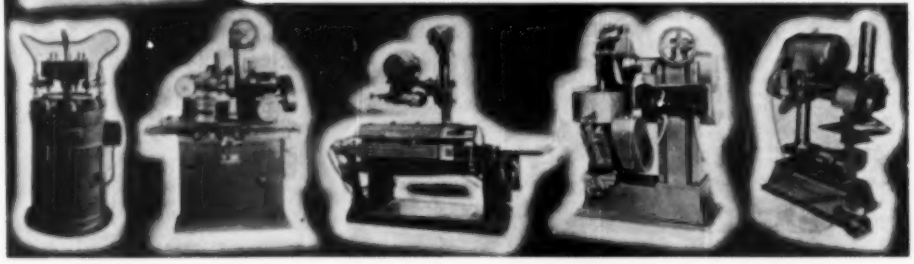

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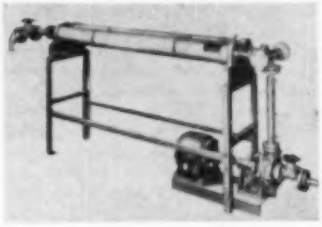
E—321. Heat Exchangers—Industrial Filter and Pump Manufacturing Company, 1621–1639 W. Carroll Avenue, Chicago 12, Ill., has just introduced a line of unit heat exchangers, the design and construction of which permit the same unit



to be used for both heating and cooling. Pure nickel tubes are used for nickel solutions, steel and special alloy tubes for other applications.

The heat exchangers can be furnished as a unit with a combination of from one to six tubes in multiple for a wide variety of heat exchange capacity. Special units are readily engineered for unusual capacity or space requirements. They are available complete with pump and stand for setting on the floor, or the tubes alone can be had separately for wall or ceiling mounting. They are easily connected to the plating system, and can be located anywhere that is convenient. For further information, use Reader Service Card.

E—322. Plating Equipment for the Jewelry Trade—Hollywood Bronze Supply, 1770 N. Vermont Avenue, Hollywood 27, Calif., which recently expanded its engineering facilities under the direction of George W. Shomin, now manufactures equipment for plating gold, silver, and copper. Fifteen-gallon tanks for gold and silver are made entirely of 18-8 columbium-bearing stainless steel electrically welded by a new method. Gold tanks which must be heated are equipped with built-in electric heating elements attached to the rear wall of the tank. Wattage of the heating element is limited so that the plating solutions cannot be overheated.

The swing-away work rod is hinged to the tank in such a way that large parts may be put in the solution without short circuiting. The company also manufactures prepared plating salts ready mixed for solution in water. For further information, use Reader Service Card.

E—323. Burnishing Compounds—The M & M Chemical Company, P. O. Box 172, Willimantic, Conn., offers two specialized burnishing compounds, Marco No. 110 for stainless steel and Marco No.

1948 Proceedings

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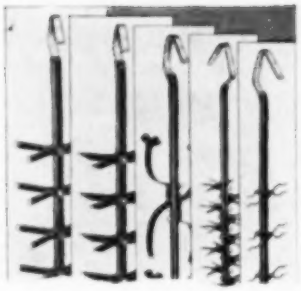
E—324. Multi-purpose Racks—Five rack models that together efficiently handle 90 per cent of all plating jobs, including bright nickel and chromium, are announced by the Belke Manufacturing Company, 947 N. Cicero Avenue, Chicago 51, Ill. Known as Belke Utility Racks, they have been developed in collaboration with experienced platers to provide maximum racking flexibility and efficiency. A supply on hand is said to enable platers to start new work immediately and to estimate plating costs accurately.



Coated with Belke Universal Plastic to withstand all cleaning and plating cycles, they have spring-pressure tips to provide positive electrical contact. New Vac-Seal removable tip assembly, used on all models, has flexible cup-shaped collar of Universal Plastic that joins the Universal Plastic Coating on the rack spine with a seep-proof seal. Interchanging tip styles is easy and broken tips are quickly replaced to maintain racks at 100 per cent capacity. Racks can also be furnished unassembled.

All models are available in 39- and 36-inch lengths for immediate shipment. For further information, use Reader Service Card.

E—325. Propeller Fans—Chicago Blower Corporation, 4358 W. Congress Street, Chicago 24, Ill., offers a new axial propeller fan which makes use of the airfoil-type blade for delivering at low speeds large volumes of air against medium to high resistance. By increasing or decreasing the number of blades and by varying the blade pitches the manufacturer has provided a complete line to meet any requirement. These new blades have diameters of from 14 to 48 inches and are adjustable to any pitch required. Blades and hubs are separate castings made of accurately machined and matched aluminum alloy. Orifice mounting panels are formed from one piece of heavy gauge steel. The combination mounting panel and orifice have been so designed as to keep turbulence and entrance-and-discharge losses at a minimum. Motors to operate the fan are supplied in various types to meet individual requirements including special motors for explosive atmospheres. The fans are designed for heavy duty applications for air cooling, man cooling, exhausting of fumes, smoke, gases, dust and other atmospheric impurities, and for drying. For further information, use Reader Service Card.

E—326. Safety Carboy Drainer—Acid splash is said to have been eliminated by the new Wahlert Safety Carboy Drainer manufactured by the Wahlert Safety Products Corporation, 25 Lafayette Street,

Brooklyn 1, N. Y. It is used in conjunction with the company's "Carboy Tilter". Uninterrupted liquid flow is guaranteed through an ingenious air vent which makes pumping or syphoning unnecessary. Every part is replaceable; its soft rubber neck fits different sized carboys; and the vent and spout are made of hard, durable, acid-proof rubber. Three sizes are available, for 1¼- to 2½-inch necks, for 2¾- to 3-inch necks and for 3¼- to 3½-inch

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There Is Something NEW Under The Sun!!!

VIOLET RAY COMPOUNDS

NO ANIMAL GREASES

NO FISH GREASES

NO MINERAL GREASES

BUFFERS AND PLATERS NOTE:

1. Quicker Cut Down
2. Higher Color
3. Direct Saving in Cost
4. Film Free Surface
5. Less Plating Rejects
6. Easy Alkali Cleaning

These Violet Ray features are to be found in a full line of: Tripoli, lime, stainless steel cut and color, finishing and jewelers' rouges.

YOU KNOW THAT . . . *SEEIN'S BELIEVIN'*

SO ACT NOW—Send the Inquiry card and ask for VIOLET RAY samples or for our representative to call on you. Then you will see VIOLET RAY Compounds HELP YOU!

RAY COMPOUNDS DIVISION
BEACON SUPPLY CO.
110 MARGINAL ST. — Dept. B
CHELSEA 50, MASS.

Equipment and Supplies

necks. For further information, use Reader Service Card.

E—327. Pneumatic Polishing Wheel—A pneumatic rubber drum inflated at low pressures is the basis of the improved "Nu-Matic Grinder", a new low-cost power-wheel unit manufactured by Nu-Matic Grinders, Inc., 10304 W. McNichols Road, Detroit 21, Mich., for grinding or polishing curved, irregular, or contour surfaces on a bench, portable, or flexible-shaft motor.

Standard abrasive bands of 5-inch diameter and 3½-inch width in a variety of abrasives (24–500 grit) can be changed from roughing to finishing in a matter of seconds by releasing the air and then reinflating with the required band in place. Weighing two pounds complete, each wheel is supplied with a single adapter to fit either ⅝ inch-11, or ½ inch-13 thread power shaft. For further information, use Reader Service Card.

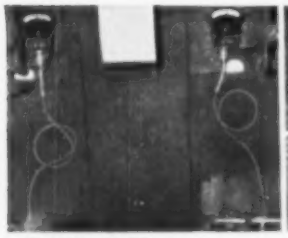
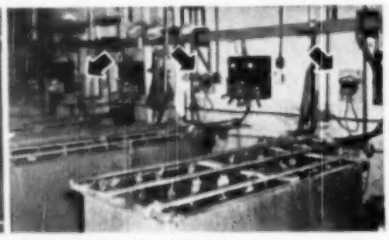
E—328. Dust Collection Control—American Air Filter Company, Inc., 215 Central Avenue, Louisville 8, Ky., offers a newly redesigned Type N Roto-Clone for collection and control of dust generated in manufacturing and process operations. Developed in 1942, the Type N unit is a hydrostatic precipitator that cleans the air by the combined action of centrifugal force and a thorough intermixing with water, the water being reused without recirculation pumps or spray nozzles. The new design, with capacities through 48,000 cfm, maintains a lower pressure drop with the same cleaning efficiency and water recirculation rate and can be operated from 50 to 120 per cent of its nominal rating without affecting its collecting efficiency. All sizes are available in either manual cleanout, sludge-ejector, or hopper-bottom arrangement. For further information, use Reader Service Card.

E—329. Spray Guns—Three new models of spray guns are announced by the Alemite Division of Stewart-Warner Corporation, 1826 Diversey Parkway, Chicago 14, Ill. They are said to handle a variety of materials, from thin liquids to heavy mastics, including materials containing high percentage of silica sand and such highly abrasive materials as sand-base sound deadeners and sand or mica insulating materials.

Features of the three new spray guns include (1) one-piece drop-forged aluminum body, with ¾-inch material inlet, (2) fluid tip of stainless steel, with funnel-shaped interior to prevent packing or clogging of high-solids-content materials, (3) air-cap of hardened and nickel-plated steel for in-and-out adjustment of particle size, (4) shut-off needle of hardened stainless steel with adjustable-collar wear compensation, (5) length of needle pull adjusted with a trigger stop to control natural flow while gun is in operation, (6) nickel plated trigger of 4-finger type, (7) trigger latch which holds trigger in open position but can be released instantly during operation to eliminate operator fatigue, and (8) built-in air-velocity regulator that can be altered without interrupting operation of gun. For further information, use Reader Service Card.

E—330. Paint Spray Booth Compound—Northwest Chemical Company, 9310 Roseclawn Avenue, Detroit 4, Mich., now offers a water-wash compound for paint spray booths, "Northwest Number One", that coats each particle of paint overspray with a non-volatile solvent. So lubricated the particles do not stick to the back curtain or any of the eliminators, the booth stays clean, and the sludge floats for easy skimming. Down-time for booth cleaning and baffle stripping is said to be eliminated while the operators work under conditions of clean fresh air at all times. Water curtain solution is easy to charge and simple to control. For further information, use Reader Service Card.

E—331. Steam Condensate Returns—Marked fuel savings are said to be one of the advantages of the "Returnal" steam-return systems made by Planert Manufacturing Corporation, 2256 W. Walnut Street, Chicago 12, Ill.; their use obsoletes steam traps, vents, etc. These savings are secured because all steam and condensate are returned to

HIGH SPEED COPPER — NICKEL COPPER AND CHROME

YOU SET IT— SARCO *holds it!*

That seems to be the universal testimonial for Sarco LSI Electric Controls among plating men. "You see each batch is different" they say. "First we experiment—up or down a degree or two—just by turning the thumb screw. When we get it just right we tell the gang to leave it alone until the next batch comes along."

During the war, a battery of 22 high speed copper tanks illustrated at the left above, ran at 200°, 24 hours a day. "Temperatures cease to be a problem the day we put in Sarco Controls" they say. Today these tanks vary from 140° to 190°—depending on the work going through.

Imagine the advantages when you have nickel, copper and chrome all going at once. One inexpensive Sarco LSI on each tank does the job.

Perfect control affects all the elements in the cost of plating. Rejects, the biggest item, are practically eliminated. Less heat is used because no heat is wasted. The amount of metal deposited is the same all day long—no waste in materials.

This Sarco Control can also be furnished for alternate heating and cooling used in chrome plating. Temperature is indicated at all times on dial cut for maximum visibility in your range.

OTHER SARCO PLATING HELPS

DEGREASING CONTROLS • UNIT HEATER CONTROLS
HOT WATER TANK CONTROLS • STEAM TRAPS

265

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Now . . Multiple Stage Cleaning engineered to fit your sequence . .

To meet today's conditions in the plating and metal finishing industry, involving changes in polishing compositions, automatic polishing, heavier and faster production and dirtier work with packed recessed areas, we offer MULTIPLE STAGE CLEANING for proper surface preparation . . A satisfactory and durable finish, regardless of the basis metal and the deposition of the coating (single or multiple), is only practical after the surface has been correctly prepared . . Whether your equipment is manual or automatic MULTIPLE STAGE CLEANING based on our well established "Lo-Hi" pH process can be engineered to fit the job . . . . . Ask the NORTHWEST man in your vicinity for his recommendation or write to us direct. . . . . All we need to know is what you are plating and your complete sequence—we'll give you the answer . . .

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pioneers in pH cleaning control—serving you since '32

Equipment and Supplies

the boiler at practically the same temperature as that of the steam already in the boiler, very little make-up water is required, and there is no waiting for steam traps to fill up and dump. These systems are offered in two models with identical specifications: Model P-1 equipped with single stage 2-hp motor with a capacity of 40,000 lb condensate per hour at 10 ft head and Model P-2 with a two-phase 3-hp motor with a capacity of 60,000 lb condensate per hour at 20 ft head. For further information, use Reader Service Card.

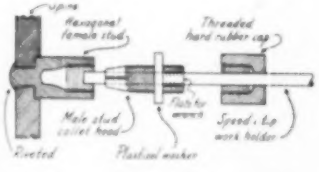
E—332. Self-Contained Spray Gun—The self-contained and portable spray gun known as the "Spray-Gat" manufactured by Sullivan-Becker Company, Kenosha, Wis., is powered by an easy-to-load, inexpensive carbon dioxide cartridge which fits into the handle. The cast aluminum body of the gun has rust-resisting brass and stainless-steel inserts. The steel container is loaded from the bottom and holds 21 ounces of liquid. This unit is an innovation in spray equipment as it can be taken to the job anywhere. It is already proving effective for touching up paint and enamel finishes. For further information, use Reader Service Card.

E—333. Electric Drying Units—The Miskella Infra-Red Company, East 73rd and Grand Avenue, Cleveland 4, Ohio, has brought out insulated Spir-O-Therm units which are interchangeable with the company's insulated infra-red lamp units. These units consist of pyrex tubes with spiral-channel resistors, stainless-steel contacts, and stainless-steel reflector.

Features of the new units are said to be (1) lower cost than lamp or strip heater equipment, (2) higher efficiency than any type of strip heater, (3) diagonal positioning eliminates hot spots and hot streaks found in horizontal 90° lamp setups, (4) efficient insulation prevents heat loss, (5) practically no transmission losses due to novel channel construction of the resistance alloy. For further information, use Reader Service Card.

E—334. Standardized Spray Washer—Detrex Spray Washers, Model WB-100-S single-spray-zone unit and Model WB-200-S two-spray-zone unit may be used as standard metal parts washers for ordinary alkali cleaning compounds, or may be easily converted in a matter of minutes to efficiently handle those compounds which have a tendency to foam excessively. According to the Detrex Corporation, Box 501, 14331 Woodrow Wilson, Detroit 32, Mich., these new washers feature standardized construction so that multiple wash, rinse and dry-off stages may be incorporated at any time at minimum cost, thus increasing the flexibility of such machines for a variety of production cleaning requirements. For further information, use Reader Service Card.

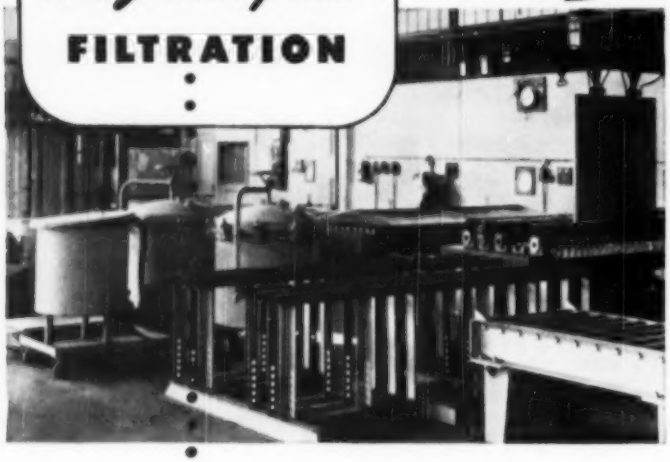
E—335. Plating Rack—Adams Engineering Company, 34 Crafts Street, Newtonville 60, Mass., offers racks with



quickly exchanged work holders, so-called "Speed-i-tips". These are available in a variety of forms and act as a small collet in a lathe—a quarter turn releases the grip on the wire. Hard-rubber cap and plastisol washer protects all machined parts and only the tip is exposed. For further information, use Reader Service Card.

SPARKLER
horizontal plate
FILTRATION

Plating solutions are circulated through this battery of Sparkler Filters in the Lukens Company plating plant at the rate of 3000 gallons per hour.



. . . . . means cleaner surfaces for cladding steel . . . . .

Lukens Steel Company, pioneer manufacturer of clad steels, has found that Sparkler Horizontal Plate Filtration is important in the production of Inconel-Clad and Stainless Clad Steel.

Here's the way it works:

Oxide film, which forms easily on the bonding surfaces of all steels, acts to prevent a strong, intimate bond between these cladding metals and backing plates. Lukens, to overcome this, applies a nickel plate finish to these bonding surfaces. In the new, modern Lukens plating plant, Sparkler filters serve as assurance that this nickel plate will be perfectly clean and free from foreign matter, thus providing the best possible surface for an inseparable bond.

The horizontal plate principle used by Sparkler makes possible the formation of firm, stable filter cakes that will not slip or crack under intermittent or continuous flow. Flow through the filter is always *with* gravity, and filter aid is floated into position, forming a strong cake of even thickness that effectively removes all solids and precipitates from plating solutions. Filters are pressure-tight and leakproof, and are available in rubber-lined construction, stainless steel, or iron. Capacities from 60 to 10,000 G.P.H.

Our Engineering Service is available for your specific problems.

SPARKLER MANUFACTURING COMPANY
Mundelein, Illinois

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 720.

PRO MAT

Reg. U. S. Pat. Off.

HIGH QUALITY, ECONOMICAL Zinc Plating and PROTECTIVE FINISHES

PROMAT *Pro-Seal* FINISH FOR ZINC

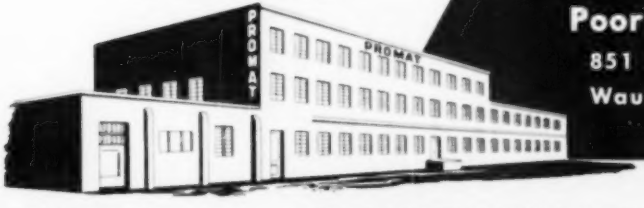
. . . so bright, durable and highly corrosion resistant that it has been adopted by the *majority* of domestic refrigerator manufacturers for the severe service imposed upon refrigerator shelving! The economical PRO-SEAL Finish can be applied to any pure zinc finish by simple dipping. A consistent product is assured by accurate analytical control and the bath can be maintained indefinitely. The *proof* is in a *test!* Submit a sample for PRO-SEAL Finish.

PROMAT C-42 ADDITION AGENT

Use of C-42 gives a high performance, workable and economical plating bath, producing a high quality zinc plate over a *very wide current density range of from 15 to 200 amps per square foot without burning.* Other characteristics — excellent coverage, good striking power, uniform distribution, high rate of deposition.

ALSO Promat Doctor Solution (an outstanding purifier for plating baths) and complete electrolytes and maintenance solutions.

Dedicated to Research for the Improvement of Metal Finishing



PROMAT DIVISION
Poor & Company
851 So. Market St.
Waukegan, Illinois

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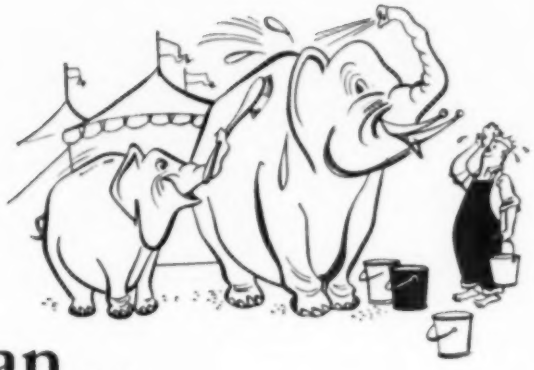
Start Clean . .



Stay Clean . .

It's Easy to Keep Your Plating Bath Clean With Red Label DARCO S-51

There's not much sense to spending a lot of time, labor, and money in cleaning work for plating then putting that work into a dirty plating bath! **Start** clean . . . **stay** clean! Use Darco S-51 to keep your plating bath free of the impurities that cause trouble.

Darco S-51 traps impurities that ordinary filtration alone does not remove—adsorbs them to **its** surfaces—before they can be deposited on the freshly cleaned surface of your work. You get better work at lower cost in bright nickel, copper, iron, zinc, cadmium, tin, gold, and silver solutions.

Red Label Darco S-51 is especially treated for use in plating—**it is the only carbon that will meet the benzol-mercury test!** Red Label Darco S-51 is especially easy to handle . . . to wet . . . and to incorporate into a slurry. Darco technicians are ready to show you how to make the most of Darco's advantages. Place an order for Red Label DARCO S-51 with your regular plating supply house today—practically all leading suppliers carry it in stock. DO NOT ACCEPT SUBSTITUTES.

Is your plating bath as clean as the water in your final rinse?

DARCO CORPORATION

60 East 42nd Street, New York 17, N. Y.

Trade Literature

L—259. Quick-Change Handpieces and Angle Heads for Flexible Shaft Machines—Machines of this kind for grinding, sanding, wire brushing, polishing, de-burring and many other operations are said to be more efficient and practical with the addition of a new invention, the WYCO Quick-Change Handpiece Coupling, developed by Wyzenbeek and Staff, Inc., 847 W. Hubbard Street, Chicago, Ill. Quick snap-on-or-off changes are made from a straight handpiece to an angle head, or from a grinder to a sander, and then to a buffer or wire brush wheel without loss of time and with complete safety to the operator.

Addition of the Quick-Change to the handpiece does not increase its size nor present any difficulties to the operator. All parts are made of heat-treated steel, cadmium plated.

The Quick-Change is now offered on all standard WYCO Flexible Shafts and Machines as standard equipment, without extra charge. Old models can be modernized with Quick-Change fittings at a nominal cost. For your copy of a new illustrated brochure use Reader Service Card.

L—260. Coated Abrasives Service—To mark completion of its modern factory for the development and manufacture of coated abrasive products, The Carborundum Company, P. O. Box 337, Niagara Falls, N. Y., has published a 32-page two-color book presenting the outstanding features of its new service, research and production facilities at Wheatfield, N. Y.

Entitled "The Finest in Coated Products ——— CARBORUNDUM", this book is illustrated with dry brush drawings and describes the closely controlled, scientific methods employed at Wheatfield which assure production of quality abrasives. In addition, it outlines the importance to industry of these abrasive products for production of more and better goods, at lower cost. For your copy, use Reader Service Card.

L—261. Book Catalogue—Interscience Publishers, Inc., 215 Fourth Avenue, New York 3, N. Y., offers its 1949 "Books and Periodicals Catalogue 1949". It includes a number of up-to-the-minute books on chemistry, physics, metallurgy and engineering. For your copy, use Reader Service Card.

L—262. Standard Samples—An up-to-date list of standard samples issued or in preparation by the National Bureau of Standards is now available. The Bureau

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All-Purpose CLEANERS

ELECTROPLATING AND POLISHING EQUIPMENT
PLATING RACKS
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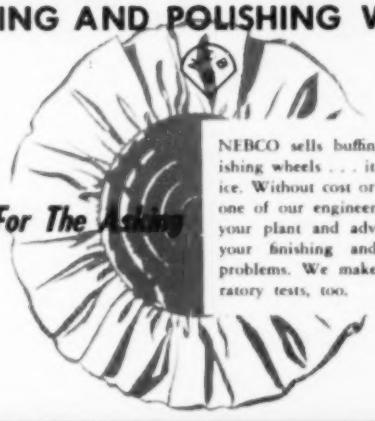
NEBCO
BUFFING AND POLISHING WHEELS



Free For The Asking

NEBCO sells buffing and polishing wheels . . . it *gives* service. Without cost or obligation, one of our engineers will visit your plant and advise you on your finishing and polishing problems. We make free laboratory tests, too.

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7338 Woodward Avenue, Detroit 2, Michigan

USE READER SERVICE CARD; INDICATE A 730.

ROTO FINISH

IS A

CHALLENGE

TO YOUR

FINISHING COSTS

CHALLENGE is the big word these days on all production jobs, if real economies are to be gained. And nothing can bear more scrutiny than the manual operations in a finishing department. For here you can substitute an efficient mechanical process—Roto-Finish—and make sizable savings!

Roto-Finish methods, materials and equipment put finishing on a production basis, processing huge quantities of parts at costs as low as 75% under tedious hand methods.

Roto-Finish is a versatile operation, adaptable to a host of different shaped parts and many surface requirements. Standard procedures make it easy to gain uniform results, maintain exacting standards, reduce rejects.

The many successful users are the answer that you, too, can profitably employ mechanical Roto-Finishing. Send sample parts for processing, and you'll have the proof! Include finished piece as guide. No obligation.

FOREIGN REPRESENTATIVES

Melbourne, Australia — A. Flavell Pty. Ltd.
London, England — Roto-Finish Ltd., 32 Bishopsgate
Windsor, Canada — F. B. Stevens of Canada Limited
Den Haag, Holland — N.V. Roto-Finish Maatschappij voor Benelux

ROTO-FINISH COMPANY
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ROTO-FINISH
ORIGINAL ENGINEERED
MECHANICAL FINISHING PROCESSES

Trade Literature

now furnishes more than 400 different kinds of standard samples, comprising materials of certified composition such as metals and ceramics, paint pigments for color, etc. Supplement to National Bureau of Standards Circular 398, Standard Samples Issued or in Preparation by the National Bureau of Standards, 19 large-sized pages containing a schedule of fees, unit weights, directions for ordering, and other information can be obtained free upon request from the Publications Section, National Bureau of Standards, Washington 25, D. C.

L—263. Synthetic Resin Cement—The Ceilcote Company, Rockefeller Building, Cleveland, Ohio has issued a 2-page pamphlet describing its Ceilcote Resin Cement. Data on chemical resistance physical properties, and method of application are included. For your copy, use Reader Service Card.

L—264. Cleaning Compounds—A 6-page illustrated folder, "Permag Cleaning Compounds for the Electroplating Industry", is available from Magnuson Products Corporation, 50 Court Street, Brooklyn 2, N. Y. It provides a brief description of the company's products for tank cleaning, tumbling and burnishing. For your copy, use Reader Service Card.

L—265. Utility Plating Racks—Bulletin 980, issued by the Belke Manufacturing Company, 947 B. Cicero Avenue, Chicago 51, Ill., gives complete information on the five models of Utility Racks that are said to handle efficiently 90 per cent of all plating jobs, including bright nickel and chromium. The improvement in rack flexibility made possible by the new Vac-Seal Removable Tip Assemblies is demonstrated. For your copy, use Reader Service Card.

L—266. Metallurgical Polishing Machines—Buehler Ltd., 165 Wacker Drive Chicago 1, Ill., has prepared an 8-page illustrated catalogue on "AB Polishing Machines for the Metallurgical Laboratory". It describes in detail a number of mechanical polishing units and accessories as well as the Buehler-Waisman Electropolisher. For your copy, use Reader Service Card.

L—267. Water Hammer Arrester—Wade Manufacturing Company, Elgin, Ill., offers a permanently sealed air chamber designed especially to eliminate the damaging effects of water hammer in any industrial or domestic application. Actual performance tests up to 60,000,000 water-hammer cycles support the manufacturer's claims of no servicing or maintenance after installation. The new "Shok Stop" arrester provides an air cushion to

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• OPERATING COST

Make this NEW
Titeflex Filter
Tops for the
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Here is the perfect answer to filtering problems in small plating shops. Designed as a *low-priced* unit, it has all of the features of larger Titeflex filters. *First*, it requires no replacement parts such as bags, pads or sheets. A few cents worth of filter-aid serves for each batch. *Second*, it is cleaned by an efficient backwash system. Waste labor is entirely eliminated.

It is available in plain steel, rubber-lined steel and stainless . . . in four sizes from one sq. ft. (delivers 400 g.p.h. open pumping) to nine sq. ft. (delivers 2280 g.p.h. open pumping).

If you want a filter at low initial cost . . . one that will operate at low cost, yet efficiently, find out about this new Titeflex model. Write for full details.

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THE FILTER WITH THE BACKWASH

For Low Cost Extra-Bright ZINC PLATING

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"DUROBRITE" ADDITION AGENT 309

(Formerly RH-309)

"DUROBRITE" ADDITION AGENT 309 OFFERS THESE OUTSTANDING ADVANTAGES

- Can be used for any type of cyanide zinc plating—in all types of plating equipment.
- Allows increased output with materials at hand.
- Increases throwing power of the bright plating range—provides greater lustre.
- Assists in consistent production of uniform bright plate.
- Provides increased economy and utility.

Highly Efficient in Barrel, Still, Semi- and Full-Automatic Units

IN MANY cyanide zinc plants, in a wide variety of operating conditions, "Durobrite" Addition Agent 309 is in regular use for consistent production of bright plating. Good formulas don't have to be changed. Nor is there any need for special equipment. Just put "Durobrite" Addition Agent 309 in *any operatable process.*

And it is surprisingly economical! Only 30 lbs. of "Durobrite" Addition Agent 309 will process from 500 to 600 tons of steel per week. It materially increases the throwing power of the bright plating range, obtaining extremely lustrous deposits even in deep recesses. And it functions in solutions varying widely in composition—performing equally well in almost any operatable zinc cyanide solution.

Large quantities of material can be steadily produced with the help of "Durobrite" Addition Agent 309 . . . through all sizes of automatic units . . . from day to day over a period of years without variation in the appearance of the work. And "Durobrite" Addition Agent 309 functions equally well in all types of plating equipment—barrel, still, semi- or full-automatic, and on almost every type or size of steel stampings.

Tune in to Du Pont "Cavalcade of America"—Tuesday Nights, NBC Coast to Coast

FOR FURTHER INFORMATION

on "Durobrite" Addition Agent 309 and other Du Pont chemicals, processes and services for electroplating, ask your Du Pont technical representative, or call or write our nearest office.

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for **ELECTROPLATING**

DU PONT

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

Trade Literature

absorb the water-hammer pressure impulse, but positively prevents water logging of the air chamber. Metal bellows allows free contraction and expansion of the air sealed within it but prevents all contact between air and water. Thus, the air chamber is continuously effective and provides constant protection against water hammer. A 12-page booklet, "The Cause and Cure of Water Hammer", contains complete details, including size and application data. For your copy, use Reader Service Card.

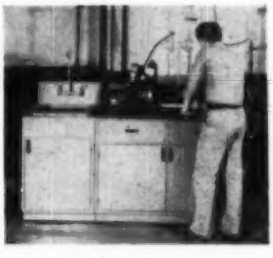
L–268. Tank Heating—The Kold-Hold Manufacturing Company, Lansing 4, Mich., offers a bulletin, "The New Platecoil for Tank Heating and Cooling" which describes the lightweight, embossed plate called a "Platecoil", used to carry the heating or cooling fluid. It has a high BTU capacity per unit area and therefore takes up little space in the tank. This bulletin shows how much easier the Platecoil is to install and maintain than pipe coils. It contains a complete description and all specifications. For your copy, use Reader Service Card.

L–269. Low Head Room Hoist—The new line of Beam-Hugger trolley hoist, manufactured by David Round & Son, 545 Henry Street, Cleveland 5, Ohio, is said to take the least head room of any hand hoist. It is built around the beam and fits it closely. When its hook is raised to maximum height, its shank touches the base of the beam. Head room is reduced to the length of the hook only, a construction which adds 17 to 51 inches more plant working space, depending upon hoist capacity. The hoists are manufactured in 13 sizes from one- to 24-ton capacity. Each hoist is available in either plain- or geared-trolley type. Hoisting mechanism employs two load-sheaves with four strands of chain supporting the load. For complete specifications and new 4-page Bulletin BH-49, use Reader Service Card.

L–270. pH Indicator Color Chart—A six-page folder issued by Hartman-Leddon Company, 5819–5821 Market Street, Philadelphia 39, Pa., contains a printed full-spectrum color chart for use with Harleco Universal Wide-Range pH indicator for approximate pH estimation, a graphic scale for locating indicators of more restricted range, and informations about new, completely water-soluble pH Indicators. For your copy, use Reader Service Card.

L–271. Ford Viscosity Cup—Henry A. Gardner Laboratory, Inc., 4723 Elm Street, Bethesda, Md., has issued a 6-page folder describing its No. 4 Ford-Type Aluminum Viscosity Cup and auxiliary equipment for determination of viscosity of lacquers, paints, varnishes, etc. The cup is machined from a block of aluminum and has a conical bottom into which is screwed a standardized brass orifice. It is said to be adjusted to an accuracy of ±2 per cent at 77 ±0.1° F. Two types of water bath are also described. For your copy, use Reader Service Card.

L–272. Test Branches Assembled from Units—Test branches for use at test stations in metal-working plants can now be had in any length and in a variety of designs by joining prefabricated steel



units recently developed and now available from stock.

Eighteen different all-steel units are available, including drawers, cupboards, sinks, tables, storage cases, etc. They are designed to be easily joined to form test benches 30 or 36 inches high. Units are two, three, four or five feet in length and make use of the newly developed plastic-impregnated stone called "Kemrock" for bench working surfaces.

The new line, called "Unitized" test benches, answers a need for heavy steel furniture, upon which to run weighing,

OBTAIN BETTER RESULTS!
USE
BUNATOL

In the field of rack insulation BUNATOL No. 1000 Paste has proven itself to be the quality insulation at the lowest price.

This free flowing 100% solids Paste is so simple to handle that the costly problem of rack insulation is quickly solved. If you have an oven to bake racks, Paste insulation can actually be used at less cost, and with remarkable long insulation life.

No. 1000 Paste cures to form an extra tough thick coating that will withstand all plating solutions and will not cut or abrade from rough handling. The insulation will last for months instead of weeks. It's permanently flexible and will not crack or peel on spring contacts.

Price is an object! First cost is much less and only a single Primer and a single top coat gives this remarkable result. It's the reason so many shops are turning to BUNATOL No. 1000. Less investment; less cost; so easy to use; racks completely insulated in a few hours.

Let us prove these points. Write for complete information and sample.

NELSON J. QUINN CO.—TOLEDO 7, OHIO

BUNATOL

PACKAGED CONTROL

where you want it

with G-E packaged power plating rectifiers

General Electric's "on-load" manual plating control provides a simple, convenient and highly dependable means of varying d-c tank voltage. The control contains stop and start buttons—a "coarse" and a "fine" switch which make 36 steps on a 230-volt system and 60 steps with a 440-volt system. Changes can be made step to step "on load"—without current interruptions. In a G-E Packaged Power Unit the manual control is normally located near the tank for the operator's convenience—while the rectifiers are tiered in another room—away from acid fumes.

FLEXIBILITY—WITH "PACKAGED POWER"

"Packaged Power" means decentralized power—with one package to power one tank at the voltage you want without rheostat losses. Each package contains its manual control and one to four rectifiers. To meet changing production needs, rectifiers may be grouped in parallel for heavy current loads or in series for higher voltages. Additional rectifiers can be added or the entire package can be shifted easily, quickly.

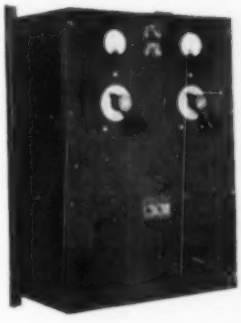
HIGH EFFICIENCY—WITH "PACKAGED POWER"

"Packaged Power" rectifiers cut your power costs. Their efficiency is better than 70 per cent from half-load to full load—approximately 60 per cent at quarter-load. Because these rectifiers use slow-aging through their virtually unlimited life.

—AND THERE'S MORE TO "PACKAGED POWER"

Yes, there are other advantages for you with "Packaged Power." There's low initial cost, low amortization cost, full mechanical and electrical protection, and more—including the large 2000-amp with automatic control or manual control, or smaller 300-amp and 50-amp packages. We'd like you to have the whole story. Ask for Bulletin GEA-5247—"General Electric Copper-Oxide Rectifiers and Controls." *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

This is "500" Packaged Power with Manual Control



MANUAL CONTROL—Together with "stop" and "start" buttons, volt and ammeter, this control has a "coarse" and a "fine" switch which make 36 steps on a 230-volt system and 60 steps on a 440-volt system. Changes can be made "on load", without current interruptions. One manual control handles one to four rectifiers.

"500" RECTIFIER—Complete within itself, this rectifier contains long-lived over-sized copper-oxide rectifier stacks. It is fully protected from electrical and mechanical failures. Fan provides even flow of air around the stacks and transformers. Removable front panel provides easy access to all parts.

Wide Current Selection with "Packaged Power"

"500" Packaged Power units in multiples of 3 kw are available for outputs of 1 to 24 volts and 125 to 2000 amps. Virtually any practical combination of voltage-current ratings are available within these wide limits.

GENERAL ELECTRIC

WE SUGGEST THAT YOU DON'T WAIT UNTIL YOUR STOCK OF ***NICKEL ANODES*** IS EXHAUSTED BEFORE ORDERING—

BUT RECOMMEND THAT IF THIS HAPPENS YOU IMMEDIATELY WRITE, WIRE OR CALL

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LARGE STOCKS OF POPULAR ANODE SIZES READY FOR INSTANT SHIPMENT TO YOU

- CAST McGEAN BESPLATE 99% PLUS
- ROLLED DEPOLARIZED 99% PLUS
- ROLLED CARBONIZED (ROCARB) 99% PLUS
- ALSO 95/97% GRADES

ALSO READILY AVAILABLE

McGEAN NICKEL SULPHATE, NICKEL CHLORIDE and NICKEL CARBONATE

Highest Commercial Quality

THE McGEAN CHEMICAL COMPANY

CLEVELAND 15, OHIO

Trade Literature

electrolytic, polarographic, colorimetric, or other tests. An illustrated catalog giving full details, dimensions, and prices can be had from the manufacturer, Fisher Scientific Company, Dept. P, 714 Forbes Street, Pittsburgh 19, Pa.

L—271. War Surplus Equipment—Acme Equipment Company, 126 S. Clinton, Chicago 6, Ill., offers a 28-page Catalogue 92 which describes a large variety of war surplus equipment said to be sold at large savings. Included are fire extinguishers, lift trucks, electric and hand hoists, compressors, polishing lathes, rectifiers, dust collectors and washing machines. For your copy, use Reader Service Card.

L—264. Wooden Tanks—Bulletin No. 22 on "Wood Tanks and Vats" containing complete data on performance and application has been issued by Wendnagel

& Company, Inc., 600 W. Cermak Road, Chicago 16, Ill. Advantage of using a wood vat is said to be its high resistance to acids and chemicals and to change of shape even when alternately wet or dry. For your copy, use Reader Service Card.

L—269. Construction Materials for Flow Measuring Instruments—Fischer & Porter Company, Hatboro, Pa., has issued a 4-page catalogue section 97 which lists a large number of chemicals and opposite each the kind of corrosion-resistant material which should be used for fittings, floats and packing in the company's Flowrator instruments. For your copy, use Reader Service Card.

L—270. Cleaners for Metals—The Hansen-Van Winkle-Munning Company of Matawan, N. J., has issued Bulletin C-106 entitled "Cleaners for Effective Metal Cleaning". A feature of this bulletin is a concise and very useful table which gives specific recommendations for the cleaning of all commonly used metals. The table covers: metals to be cleaned, soil to be removed, recommended soak and electrocleaners, and special notes applicable to unusual type of work. Type, use, temperature ranges, and recommended concentrations and current densities of a large number of the company's cleaning materials are included. For your copy, use Reader Service Card.

Porosity (Continued from page 928)

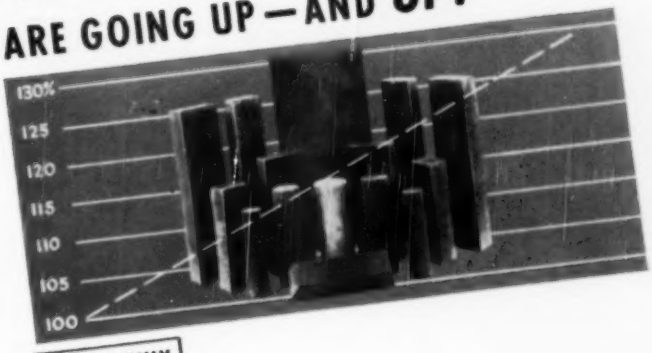
plored will prove to represent but an extended initial "induction" stage of very slow corrosion; it may also be that, in the case of *IV* and of *IIb, c*, corrosion will ultimately set in after a very long induction period. Answers to these questions will be provided by longer-range exposure experiments, now in progress.

Another interesting point is the slowness of corrosion in all cases investigated. By their chemical composition, i. e., the very high concentration of the corrosive reagent, our media *a* and *b* should be *drastically* corrosive, and the slow progress of the corrosion—detectable only by the very fine air-permeability test, without any visible signs of attack, is surprising. This would tend to indicate that in corrosion on exposure to natural surroundings, factors other than purely chemical reactions between the metal and the corrosive reagent play a determining role. In particular, the effect of solid particles settling on the surface of the metal—a factor which, so far, we have knowingly excluded from our experimentation—and, for example, creating local potential differences, will possibly prove to be decisive. Also, in our laboratory tests and in contrast to natural exposure, the surrounding medium is homogeneous and stationary and can give rise to no local concentration cells.

Acknowledgment

We wish, once more, to acknowledge the interest and constant help of Dean Hugh S. Taylor.

SALES OF SPEEDIE BUFFING AND POLISHING COMPOSITIONS ARE GOING UP—AND UP!



HERE'S WHY

Because more and more production and job shops tried *Speedie* Compositions and learned for themselves the superiorities and uniformity of these "laboratory-quality" products—then ordered again and again in ever larger quantities—*Speedie* sales climbed over 25% above last year!

YOU will find too, that every product in the *Speedie* line is job-proved to do a particular finishing job—better! Write today for full information about the *Speedie* Compositions your plant needs—Stainless Steel and Chrome, Tripoli, Nickel Finish, Satin Finish, etc. Address Dept. P for a copy of our new, free catalog.

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All Machine Screws Gage checked and Plated to Gage Fit

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ROLLED OR BUFFED FINISHES

Automatic Buffing of Screws, Shells, Caps.

ALL PLATING INSPECTED

Rejects refinished and work returned complete.
Will stand Crimping and Bending.
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SPECIFICATION PLATING

Plating thickness and Corrosion Resistance assured by
Magna-Gage and Microscopic Thickness Tests and Salt Spray
Complete Laboratory Control.

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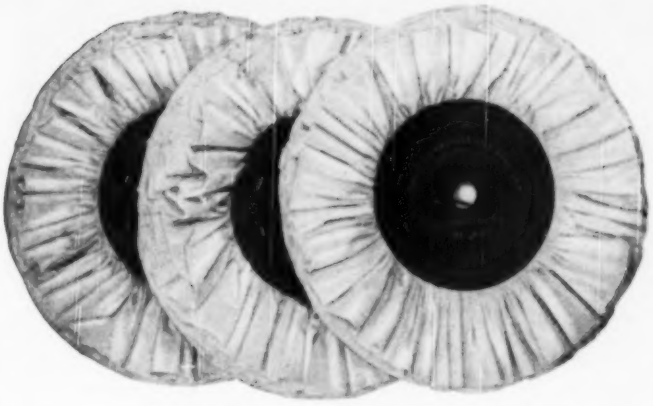
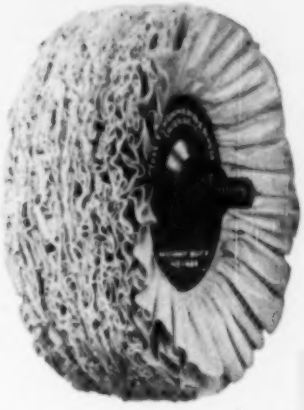
Assistance gladly rendered on Dimensional Allowances or other Plating Problems. No Obligation. Samples plated without charge.

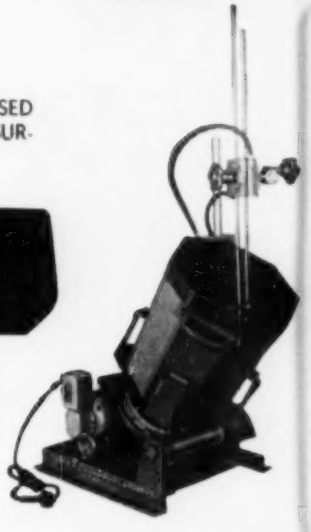
RELIANCE PRODUCTS





NUWAY BUFFS

MANY FOLDS TO HOLD COMPOSITION USED FOR FAST CUTTING, FLAT AND ROUND SURFACE WORK.



EXTRUDED COMPOSITIONS

MORE COMPACT, NO LOSS FROM BREAKAGE, MORE ECONOMICAL.

RELIANCE MIDGET PLATING BARREL

TUB CAN BE LIFTED OUT FOR DUMPING AND TUMBLING BARREL INSERTED FOR TUMBLING INSTEAD OF PLATING—VERY RIGID—THREE SPEEDS.

Chas. F. L'Hommedieu & Sons Co.

MANUFACTURERS of

Plating and Polishing Machinery

Complete Plating Plants Installed

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For better, faster cleaning of ZINC DIE CASTINGS...at lower cost

Because it allows higher current density through better conductivity and also permits the use of higher temperatures, Z-54 is especially efficient in cleaning hard to remove soil and avoiding blisters.

Z-54 contains carefully balanced anhydrous alkali ingredients plus a combination of surface active agents. Developed for reverse current cleaning prior to electroplating, it is concentrated, anhydrous, free-flowing, granular and 100% active.

This is a most important new development in the cleaning of zinc based die castings. Investigate Pennsalt Z-54 now. Our technical representative will be glad to help you set up tests. Special Chemicals Division, Pennsylvania Salt Manufacturing Company, Philadelphia 7, Pa.

PENN SALT
metal cleaning compounds

FOR FURTHER INFORMATION, USE READER SERVICE CARD: INDICATE A 740.

A. S. T. M.-A. E. S. SPECIFICATIONS FOR PLATED COATINGS

All numerical requirements refer to minima on significant surfaces.

Zinc on Steel: A164

Coating	Type G.S.	Type L.S.	Type R.S.
Zinc, inch	0.001	0.0005	0.00015

Cadmium on Steel: A165

Coating	Type N.S.	Type O.S.	Type T.S.
Cadmium, inch	0.0005	0.0003	0.00015

Nickel-Chromium on Steels: A166

Coating	Type D.S.	Type F.S.	Type K.S.	Type Q.S.
Copper plus nickel, inch	0.0020[a]	0.00125	0.00075	0.0004
Final nickel, inch	0.0010	0.0006	0.0004	0.0002
Chromium (if required), inch	0.00001	0.00001	0.00001	0.00001
Resistance to standard salt spray, hours without appreciable corrosion	96	72	48	16

[a]When copper is used in excess of a thickness of 0.0001 inch, its minimum thickness shall be 0.00075 inch.

Nickel-Chromium on Copper and Copper-Base Alloys: B141

Coating	Type F.C.	Type K.C.	Type Q.C.
Nickel, inch	0.0005	0.0003	0.0001
Chromium (if required), inch	0.00001[a]	0.00001	0.00001

[a]Maximum thickness should be kept below 0.00005 inch to prevent cracking.

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Nickel-Chromium on Zinc and Zinc-Base Alloys: B142

Coating	Type F.Z.	Type K.Z.	Type Q.Z.
Copper plus nickel, inch	0.00125	0.00075	0.0005*
Copper, inch	0.0004	0.0003	0.0002
Final nickel, inch	0.0005	0.0003	0.0003
Chromium (if required), inch	0.00001	0.00001	0.00001
Resistance to standard salt spray, hours without appreciable corrosion	48	32	16

*Total of 0.0003 inch if alternative of nickel only is used.

Lead Coatings on Steel: B200

Type	Copper inch	Lead inch	Salt spray Resistance* hours
E.S.	.....	0.0010	96
EE.S.	0.000015	0.0010	96
M.S.	.....	0.0005	48
MM.S.	0.000015	0.0005	48
P.S.	.....	0.00025	24
PP.S.	0.000015	0.00025	24

*To standard salt spray test in hours without appreciable corrosion.

Chromate Finishes on Zinc: B201

With two crossing, 1-inch long scratches through the chromate coating only, the part shall show no white corrosion visible to the unaided eye at normal reading distance after 24 hours in a standard salt spray test.

Postage Will be Paid by Addressee

BUSINESS REPLY CARD
First Class Permit No. 11, Sec. 510, P. L. & R., Jenkintown, Pa.

PLATING
P. O. BOX 168
JENKINTOWN, PA.

Attn.: Reader Service Department

No Postage Stamp Necessary if Mailed in the United States

A. E. S. News

The First A. E. S. Gavel

The gavel used to open the first A. E. S. Convention, held in Chicago in 1914, has been sent to the Executive Secretary's office for safekeeping by A. E. S. first president George B. Hogaboom.

To it are fastened a red, a white, and a blue ribbon, which were attached by a daughter of the late Oscar E. Servis, the Society's sixth president.

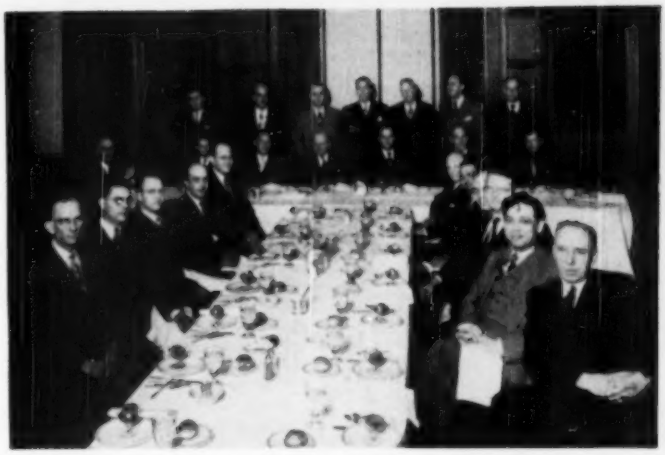
MacStoker

Third Vice-President MacStoker

To add to the introduction of the newest member of the Society's Executive Board we show here a picture of Mr. MacStoker which arrived too late for last month's issue.

President A. W. Logozzo Honored

The Hartford Branch will give a reception for its illustrious member, A. E. S. President Logozzo, on September 17. Members of other New England Branches are invited. George B. Hogaboom, A. E. S. first president, will be the chairman.



From a meeting of the last A. E. S. Executive Board with officers and committee chairmen of Detroit Branch

Research Committee Appointments

The Executive Board has selected W. A. Pinner, Houdaille-Hershey Corporation, Detroit; G. M. Cole, Ternstedt Division, General Motors Corporation, Detroit; and J. J. Duffy, Jr., Pennsylvania Salt Manufacturing Company, Philadelphia, as new members of the Research Committee.

They succeed Drs. Louis Weisberg, R. A. Schaefer and H. L. Kellner, who finished their three-year terms. All of them have given freely of their time and ability to the committee's work; Drs. Weisberg and Schaefer as Chairman and Vice-Chairman, respectively, and Dr. Kellner as Chairman of the Finance Subcommittee.

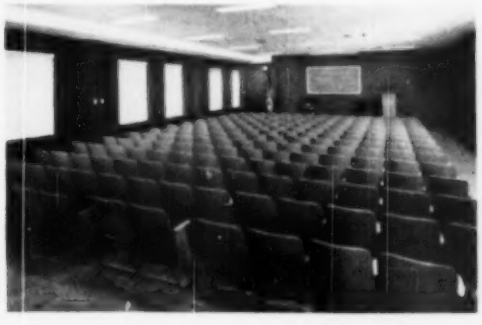
Chairman W. M. Tucker announces the appointments of B. C. Case of Hanson-Van Winkle-Munning Company, Detroit, as Chairman of the Research Directing Subcommittee and H. J. Struckhoff, Lasalco, Inc., St. Louis, Mo., as Chairman of the Research Finance Subcommittee.

The Vice-Chairman of the Research Directing Subcommittee are G. M. Cole, who supervises Projects Nos. 5, 11, and 12; Dr. W. A. Wesley of The International Nickel Company, Bayonne, N. J., who is in charge of Projects Nos. 6, 7 and 9; and Dr. R. M. Wick of Bethlehem Steel Company, Bethlehem, Pa., who has jurisdiction over Projects Nos. 2, 4, and 10.

The Chicago Branch Becomes Well Fixed

After a great many years at the Atlantic Hotel, the Chicago Branch has changed meeting place. By arrangement with the Western Society of Engineers, three floors of their building will be made available for monthly meetings. The fifth floor has a modern restaurant open only to members of cooperating societies and their guests. The sixth floor possesses a large lounge and bar. The meeting room is on the seventh floor and has a seating capacity of 200. Upholstered theatre-type seats contribute greatly to its comfort. All types of projection equipment and an excellent public address system are excellent aids to the speakers.

The location of the Western Society building is very desirable. Next to it is the world-renowned Crerar Library of technical literature. Practically all means of public transportation are within a block.



Auditorium, Western Society of Engineers

Lounge, Western Society of Engineers

IRIDITE

keeps zinc plate
STAIN FREE,
SPARKLING
BRIGHT

on

Because it *economically* gives lasting, chrome-like brightness to zinc or cadmium plate, Iridite Bright is the final finish on hardware for The Cleveland Welding Company's famous Roadmaster Bicycle.

Shop-wise, Iridite Bright offers many advantages: a simple chemical dip, ease and speed of operation, non-electrolytic, requires only usual plating shop equipment and operators. And you get uniform consistent results from manual or automatic processing operation.

A few of the many applications for Iridite Bright include wire products, such as baskets and refrigerator shelves, electrical parts, such as radio chassis and speaker frames, and many other zinc or cadmium-plated parts or assemblies.

Other Iridites provide amazing corrosion resistant finishes and excellent paint adherence for all zinc and cadmium surfaces—die-cast, galvanized or plated.

Does this give you any ideas for your own products? Then write today for descriptive folder and samples. Or send your product samples for *free processing*.

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Convention Review

(*Continued from August*)

International Fellowship Club Celebrates 25th Anniversary

Not less than 141 plating and polishing supply house representatives met, with Mr. Louis M. Hague in the chair, at Monday noon to celebrate the silver anniversary of their own organization. This was in great contrast with the day, or rather night, because it happened at 3 A. M., when four men 25 years ago decided that the supply people as a group had much in common and much to contribute to the plating business and the A. E. S.

That occasion and the next few years were recalled to mind by Mr. Wilfred McKeon, "Sulphur Mac", when he gave the principal address of the luncheon.

The celebration also commemorated the 20 years of faithful service as Permanent Secretary of Mr. Thomas Trumbour. His company, Finishing Publications, Inc., was the gracious host of the luncheon, a lavish cold-cut affair which can be found only in Milwaukee.

According to Mr. Trumbour's report the club counted on spending not less than $2,300 to entertain the Convention at the traditional Open House, the Ladies' Card Party and the Golf Tournament, a sum which had been collected from 151 supply houses.

The election of officers for the year 1949-1950 resulted in an advancement of all vice-chairmen. The new chairman is Mr. R. Hazucha of Clinton Lacquer Company, besides Mr. McKeon the only man who attended the organization meeting of the group. First and Second Vice-Chairmen are Messrs. George L. Nankervis of George L. Nankervis Company and A. P. Munning of Munning and Munning Company. The new officer is Third Vice-Chairman Al Braun of Agate Lacquer Company.

It is difficult to say much about the contribution of this group to the success of the Convention. All that can be has been said each year. The generosity and good will displayed is simply overwhelming. Two items of special significance however, should not go unmentioned. They are the beautiful silver service for eight and the silver tea set which, in honor of the silver anniversary, were given to lucky winners at the Open House. And they were only a few of the many door prizes.

National Association of Metal Finishers

This job shop organization held a dinner meeting on Tuesday evening at which announcement was made of new officers and directors:

President—Harold F. Coombes, Crown City Plating Company, Pasadena, Calif.

First Vice-President—W. O. Zinn, National Plating Company, Chicago, Ill.

Second Vice-President—William F. Walton, Walton and Lounsbury, Attleboro, Mass.

Third Vice-President—F. A. Trudeen, Southern Finishers, Inc., Nashville, Tenn.

Treasurer—G. Burgess, Electro-Plating Service, Inc., Ferndale, Mich.

New Directors—Bruce E. Warner of New England Plating Company, Inc., Worcester, Mass.; J. P. Maloney, Western Rust Proof Company, Chicago, Ill.; Oliver Pendlay, Cadmium and Nickel Plating Company, Los Angeles, Calif.

Adolph Bregman, Executive Secretary of the New York organization, discussed the difficult business and labor conditions in his area. Dr. George P. Swift, who holds the same position in Boston, which has no unions in this field, described the problems of competition and pollution encountered by his people. Other speakers talked for the Detroit, California, and Mississippi Valley districts. A common complaint was the poor quality of work put out by polishers at far from poor prices.

Raymond M. Shock of Detroit is the Executive Secretary of the National Organization.

Exhibits Award Committee

The following served on the Exhibits Award Committee, according to E. C. Bost, Exhibits Chairman: Richard Jager, Grand Rapids Branch; Frank Savage, Chicago Branch; Jerome Weller, Twin City Branch; W. B. Knight, Detroit Branch.

The committee was assisted by C. F. Nixon, now A. E. S. Second Vice-President.

Miscellaneous Notes

Two of the newly elected Honorary Members, John Lockerbie and Frank C. Rushton, were not at hand to receive their certificates on Thursday afternoon, the former because of illness incurred during the Convention which kept him in his hotel room from Tuesday on, the latter because of the long distance from Los Angeles. Both have written to the National Office and expressed their delight at the honor bestowed upon them.

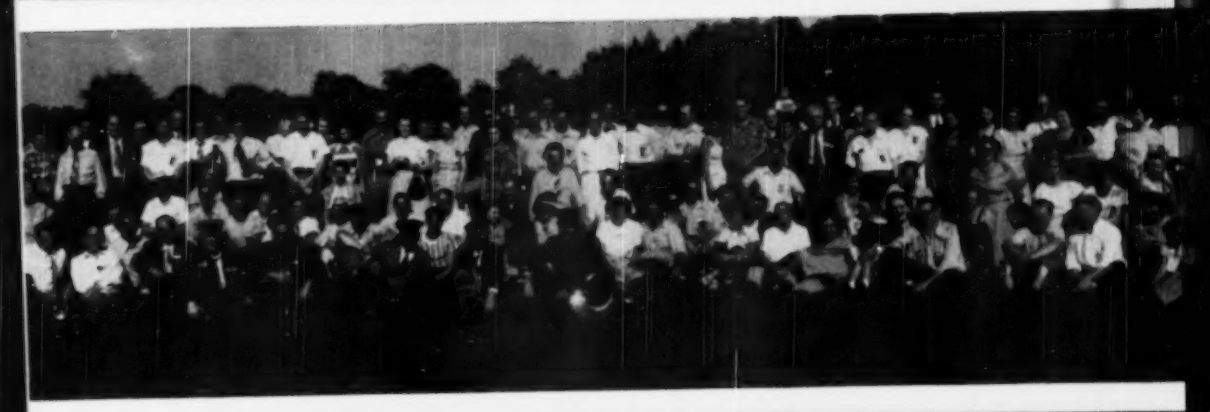
Jerry De Grazia, who, due to a serious illness of his wife, had to miss this Convention, has asked us to thank John Lockerbie and his other friends who sent

him a postal card from Milwaukee with their best wishes.

Acknowledgment

Few convention visitors appreciate how much money it takes to run a convention in the lavish way to which registrants have been accustomed. The $10.00 registration fee does not nearly pay for the entertainment and incidentals. It has therefore been up to the local Convention Committee to raise additional funds.

The success of the Milwaukee Convention was to a large extent due to the generosity of a number of firms, many of which also helped finance the International Fellowship Club affairs. Acknowledgement and thanks go to A. B. Plating Supply Company, Allied Industrial Products Company, Allied Research Products Company, Alsop Company, American Buff Company, Apothecaries Hall Company, Ardeo, Inc., Azed, Inc., Belke Manufacturing Company, Bias Buff and Wheel Company, Buckingham Products Company, The Chemical Corporation, Detrex Corporation, The Diversey Corporation, Donald Sales and Manufacturing Company, Formax Manufacturing Corporation, Frederick Gumm Chemical Company, Inc., Hanson-Van Winkle-Munning Company, Harshaw Chemical Company, Jacob Hay Company, R. O. Hull & Company, Inc., Industrial Filter and Pump Manufacturing Company, International Nickel Company, Kocour Company, Lasalco, Inc., Lea Manufacturing Company, Charles G. L'Hommedieu & Sons Company, Maas and Waldstein Company, Mac Dermid Incorporated, The Manderscheid Company, Matchless Metal Polish Company, The Meaker Company, Mercil Plating Equipment Company, J. C. Miller Company, Mitchell-Bradford Chemical Company, Northwest Chemical Company, O'Donohue Sales Company, Pennsylvania Salt Manufacturing Company, Promat Division, Pope & Company, Nelson J. Quinn Company, Redi-Products Company, Sparkler Manufacturing Company, Standard Plating Rack Company, F. B. Stevens, Inc., The Sturgis Products Company, George Stutz Company, Turco Products, Inc., The Udylite Corporation, United Chromium Corporation, Wyandotte Chemicals Corporation.



Branch News

BRIDGEPORT BRANCH

At the regular meeting on June 3 attended by thirty-seven, William Enescionna reported on the very successful banquet held on May 28. In recognition of his services, he was appointed chairman of the Outing Committee for August 27.

C. C. Helmle presented the recommendations of the committee appointed to streamline the business sessions. They were approved with a minor amendment. The officers and members of the Board of Managers will meet at 7:00 P. M. preceding the business meetings at 8:00 P. M.

Three men were elected to active membership.

The next meeting will be held on September 9.

Refreshments were served through the courtesy of W. H. Lindsay, Jr., of the Chemical Corporation, Springfield, Mass.

Joseph G. Sterling,
Secretary-Treasurer

CHICAGO BRANCH

A business-dinner meeting was held on July 22, 1949 and was well attended by fourteen members. The feature of the meeting was the inspection of the facilities offered by the Western Society of Engineers and to decide upon a change of meeting place. A motion was made and passed to adopt the Western Society of Engineers, 84 E. Randolph Street, Chicago, Ill., as a future site for the monthly meetings. We are extremely fortunate in that our new location has three floors, well appointed with numerous facilities. Our regular meetings will continue to be held on the second Friday of each month. We will have our first meeting of the new term this September.

Raymond F. Ledford, *Correspondent*

COLUMBUS BRANCH

A meeting of the Officers and the Board of Managers was held on July 21 at Battelle Institute to line up the meetings for the coming year. Attending newly elected officers were:

President—John Beach (Battelle)
First Vice-President—William Balzer (State Plating)
Second Vice-President—Walter Denney (Belmont Casket)
Secretary-Treasurer—Nate Kaslin (Natlin Laboratories)
Librarian—Ed Bride (Battelle)
Board of Managers—William Neill (Columbus Metal Products), Cloyd Snavely (Battelle), and Arch Tripler (Battelle)

Our first regular meeting of the year will be held on September 2 at Battelle, 8:00 P. M. sharp. The Columbus Exhibit, which won first prize at the Milwaukee Convention, will be displayed. We will have a discussion on "How To Figure Cost of Any Plated Article", led by William Neill, William Balzer and Cloyd Snavely.

Walter Denney,
Second Vice-President

MELBOURNE BRANCH

Instead of the usual lecture and discussion the June regular meeting took the form of an inspection of the Essendon Workshops of Trans-Australia Airlines on June 23.

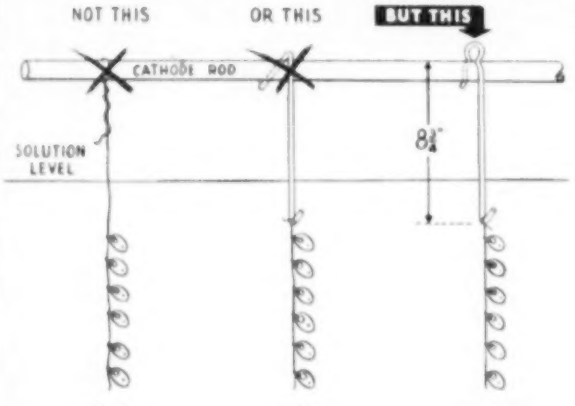
Approximately sixty-five members and visitors attended and were first shown the very modern and well equipped plating and heat-treatment section. A feature of the plating shop was the 13-foot deep anodizing tank for treating propellers.

The party was then taken on a tour of the entire plant, including the engine overhaul and assembly line, the instrument shops, and the hangars where members had an opportunity to inspect various types of airliners at close quarters.

When wiring short run parts where a plating rack is not warranted . . .

ADAMS *"Speed-i-grip"* WIRING HOOK

CUTS COSTS—SAVES TIME—STOPS REJECTS



1910
Grandpa used this old-fashioned method of wiring in the early days of plating.
SLOW—DANGEROUS
COSTLY

1930
Dad bought a few copper rods and made hooks like these. Some still make them—an improvement but still costly with hit-or-miss contact when plating small lightweight parts.

1950
The ADAMS "speed-i-grip" is the most modern, and efficient plater's hook ever devised. Tight positive contact on cathode rod eliminates rejects, cuts down plating time and insures perfect plating. Mass produced "Speed-i-grips" cost less than your own hand made hooks. ONCE USED, ALWAYS USED.

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Branch News

At 11:00 P.M. President Keith Leigh moved a vote of thanks to the company and the guides who had so effectively dealt with the large attendance.

Branch members and their friends were guests also at an earlier plant visitation on May 25 when Foundation President Morrie Andrews threw open his plant, The Nella Enameling and Electroplating Company, Pty. Ltd., for inspection. The main object of interest was the newly installed organic-type bright nickel plant, but the "production line" for plating of auto bumpers was also impressive. Timely and welcome refreshments rounded off an enjoyable evening.

John J. Dale, *Honorary Secretary*

MONTREAL BRANCH

Fifty-four members and guests were present at the regular monthly meeting on June 7 when one applicant was elected to membership.

Mr. A. W. Lozzazzo, First Vice-President of the A. E. S., gave an illustrated lecture on "Bright Nickel and Decorative Chrome Problems". (See June issue of Plating.)

The question period which followed showed that the audience had been very intent on the lecture. The slide projector and screen were supplied through the courtesy of the R. C. A. Victor Company, Montreal.

A banquet committee was formed consisting of J. H. Charles, Chairman; P. M. Coady, J. G. Carrique, R. King, and J. T. Reisenburg.

The next regular meeting will be held on September 6, 1949.

George R. King,
Secretary-Treasurer

SYDNEY BRANCH

The 55th regular meeting on May 10 at Sydney Technical College drew over forty-two members and visitors.

Dr. Murphy, Principal of the Sydney Technical College, and Mr. B. W. Armstrong, Lecturer in Electroplating, were the featured speakers. Dr. Murphy gave a most interesting talk on the plans for future development of the Technical College which includes the engagement of leading overseas technologists and considerable expansion of the present Electroplating Section. He also drew the attention of those present to the need to strive constantly to raise the standard of their finish. This was necessary to keep plating at its present level and prevent the encroachment of alternative methods of metal finishing. Further he pointed out that new developments, such as the jet engine, were continually making new demands on plated finishes and technique and that it behooves the trade to keep abreast of these.

Mr. Armstrong then showed two interesting films on the "Theory of Electroplating" and gave a talk on the questions raised by them. He then answered a number of questions put by members which indicated the success of his lecture.

T. O. Kolts, *Secretary-Treasurer*

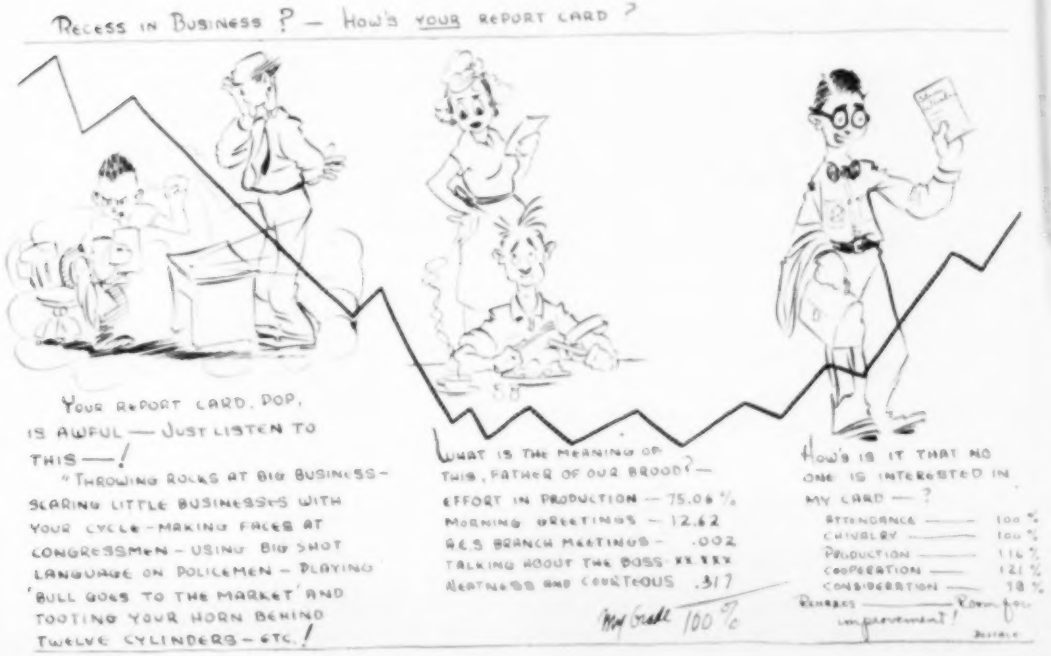
SYDNEY BRANCH

Two new members were received at the 56th regular meeting on June 14 at Manufacturers House, Mr. F. R. Bellenger presiding over thirty-five members and visitors. After general business was conducted a ballot was held for two proposed members, both of whom were elected.

Mr. R. Speans, Overseas Representative of W. Canning & Company, gave a most interesting talk on "Plating in Post-War Britain". He described the initial change-over to war production and then back to post-war production, and also discussed the trend as far as solutions and equipment were concerned. A number of questions were asked at the conclusion of his address and were ably answered by the speaker.

An innovation, the presentation of a door prize, was then conducted; a fine table lamp presented by the President was won by one of the members.

T. O. Kolts, *Secretary-Treasurer*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"Throwing rocks at big business — scaring little businesses with your cycle-making faces at congressmen — using big shot language on policemen — playing 'Bull goes to the market' and tooting your horn behind twelve cylinders — etc.!
What is the meaning of this, father of our brood? —
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Morning greetings — 12.62
A.E.S. branch meetings — .002
Talking about the boss xx xxx
Neatness and courteous .317
My Grade 100 %
How's is it that no one is interested in my card — ?
Attendance 100 %
Chivalry 100 %
Production 116 %
Cooperation 121 %
Considderation 18 %
Remarks — Room for improvement!

Hydrogen Embrittlement

(*Continued from page 913*)

copper plate further decreases the angle to below 60 degrees.

8. When embrittlement does develop in the mild steel, the steel characteristically recovers during prolonged plating periods, whereas the stainless steel does not usually exhibit that effect.

9. After aging at room temperature for 33 months, the stainless steel specimens given a maximum 32-minute plate are found virtually all recovered except those with the acid-copper plate over a cyanide-copper strike, which still registered failure at only 70 degrees of bend.

ACKNOWLEDGMENT

Acknowledgment is made to the Office of Naval Research for its support of a fundamental research project on gas-metal systems from which the present paper stems as a special study.

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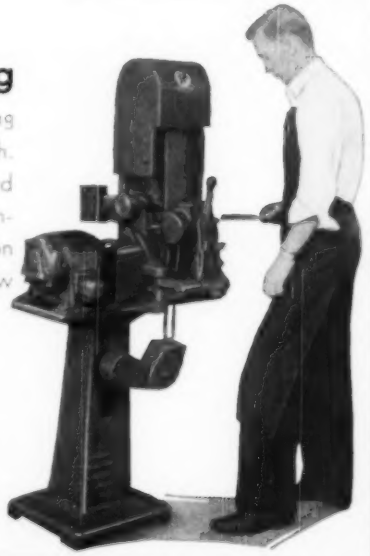

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ST. LOUIS BRANCH: James M. Bailie, Louis J. Berra, David Finney, Paul A. Froeschl, Jr., John O'Malley, Carl J. Sommers, Jose L. de Toledo Piza

SYDNEY BRANCH: E. J. Cousins, C. W. Gilbert

Reinstatements

WATERBURY BRANCH: Frederick Batten

Transfers

Bruce Darling from Baltimore-Washington Branch; H. J. Huester to Baltimore-Washington Branch; H. Don Crim to Chicago Branch; Eugene Coulis from Columbus Branch; G. S. Woodruff to Pittsburgh Branch; Leland D. Hawkins from Membership-at-Large to Pittsburgh Branch; Michael F. Spirito from Providence-Attleboro; V. A. Nieberlein to St. Louis

Resignations

ADELAIDE BRANCH: L. W. Apps, R. W. Burley, B. H. Wells, E. Webb

HARTFORD BRANCH: J. F. Yeamans

MELBOURNE BRANCH: A. Edmonds

PITTSBURGH BRANCH: William A. Rodger

ST. LOUIS BRANCH: Jerome Czarnecki, A. E. Breese, Lee Evans, Alvin Mueller, Art Musick, E. V. Nay, Otto Reber, Harold Weisenborn

WATERBURY BRANCH: Robert J. Green

Deaths

BOSTON BRANCH: Charles O. Hardy

NEW HAVEN BRANCH: Joseph L. Downes

MEMBERSHIP COMPETITION

	Membership April 1, 1949*	New Members	Net Change in Membership	Per Cent Net Change
FIRST GROUP				
CLEVELAND	186	12	+13	+ 7.0
NEW YORK	265	21	+18½	+ 7.0
DETROIT	427	34	+29	+ 6.8
MILWAUKEE	132	6	+ 4	+ 3.0
PITTSBURGH	135	9	+ 3½	+ 2.6
CHICAGO	391	16	+ 8	+ 2.0
PHILADELPHIA	187	6	+ 3½	+ 1.9
HARTFORD	133	5	+ 2	+ 1.5
LOS ANGELES	217	9	+ 1½	+ 0.7
BRIDGEPORT	160	3		
GRAND RAPIDS†	160			
BOSTON	153		− 2½	− 1.6
NEWARK	256	2	− 5½	− 2.1
TORONTO	154	6	−17	−11.0
SECOND GROUP				
BUFFALO	82	6	+ 7	+ 8.5
SYDNEY†	108	6	+ 6	+ 5.6
BALTIMORE-WASH.	83	5	+ 4½	− 5.4
INDIANAPOLIS	104	5	+ 3	+ 2.9
MELBOURNE	81	4	+ 2	+ 2.5
DAYTON	98	2	+ 1½	+ 1.5
PROV.-ATTLEBORO.	109	3	+ 1½	+ 1.3
CINCINNATI	90			
NEW HAVEN	108			
ST. LOUIS	107	7	− ½	− 0.5
WATERBURY	122	2	− 1	− 0.8
ST. JOSEPH VALLEY	80		− 1	− 1.2
SYRACUSE	83	2	− 4	− 4.8
ROCHESTER	125		−10½	− 8.4
THIRD GROUP				
SOUTHEASTERN	38	4	+ 4	+10.5
LOUISVILLE	20	2	+ 1½	+ 7.5
COLUMBUS	38	3	+ 2½	+ 6.6
SPRINGFIELD	50	2	+ 2	+ 4.0
ALLENTOWN-READING	43	1	+ 1½	+ 3.5
TOLEDO	56		+ ½	+ 0.9
ROCKFORD	56			
JACKSON-LANSING	59			
LANCASTER	59	1		
SAGINAW VALLEY†	67			
ADELAIDE	76	4		
TWIN CITY	77	1		
MONTREAL	69	3	− 1½	− 2.2
SAN FRANCISCO	71	10	− 2	− 2.8
OUTSIDE COMPETITION				
HAMILTON		14	+20	
WESTERN ONTARIO		15	+15	
AT LARGE	100	8	+ 3	
IN TRANSFER	22		+ 7	
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*Subject to correction. †Winners of membership competition in 1948–1949.

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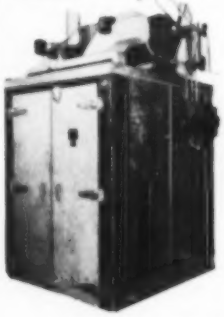

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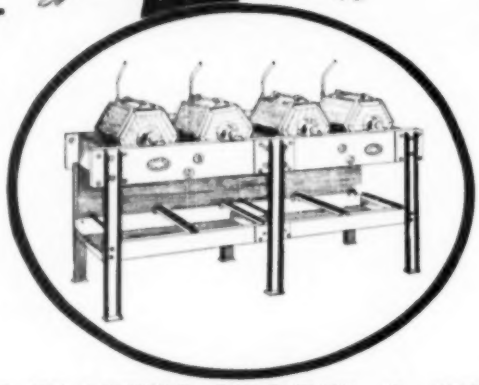

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plating

September 1, 1949

Dear Reader—

The award of the A.E.S. Gold Medal during the recent American Electroplaters' Society Convention in Milwaukee to C. F. Nixon for his article, "A Plater's View of Designing" in the March, 1949 issue of PLATING emphasizes the important relationship between electroplater and designer. Not only did Mr. Nixon handle his material exceedingly well, as the award testifies, but the subject itself deserves unusual attention.

The industrial designer is essentially an artist who, in creating his concept of products, specifies not only shape but finish. The finish must be wedded to the shape to make a pleasing whole that will attract buyers to the product and may, in the final analysis, represent the difference between a responsive and a nonresponsive market for that product.

The electroplating industry must be certain that the industrial designer understands what it has to offer to a manufacturer producing a new or revamped item for sale. It must, in plain words, take pains to "sell" the plated coating as a beautiful, durable finish when appropriately used. Plating must be kept uppermost in the kit of tools that will help the designer.

PLATING, of course, does not reach most of the industrial designers. But many of the readers of PLATING come in contact with these creative artists. It is hoped that upon such occasions the readers will do their best to bring plating as a finish into sharp focus.

Sincerely,

Gustaf Soderberg

Editor

Future Meetings

Fourth National Instrument Exhibit and Conference in St. Louis, Mo., Municipal Auditorium, on September 12-16.

International Association of Electrotypers and and Stereotypers 52nd Annual Convention in Montreal, Canada, on September 18-21.

American Society for Testing Materials First Pacific Area National Meeting in Fairmont Hotel, San Francisco, Calif., on October 10-14.

American Society for Metals 31 Annual National Metal Exposition and Congress in the Public Auditorium, Cleveland, Ohio, on October 15-21.

National Safety Council Annual Meeting in Hotel Stevens, Chicago, Ill., on October 24-28.

Philadelphia Branch, A. E. S. Annual Educational Session (2 P. M.) and Banquet (7 P. M.) in Broadwood Hotel, on November 19.

Plant Maintenance Show and Conference in the Auditorium, Cleveland, Ohio, on January 16-19, 1950.

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"That makes selecting the right cleaners for your work serious business," I continued. "Besides considering detergency value, you've got to think about such things as attack on metals, emulsifying power, electrical conductivity, chemical stability, and service life. And no one cleaner can do all jobs equally well.

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